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SCIENCE & TECHNOLOGY

USSR: SPACE

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FINAL PREFLIGHT PROCEDURES FOR SOVIET-SYRIAN CREW

Moscow IZVESTIYA in Russian 21 Jul 87 p 3

[Article by B. Konovalov, correspondent at the Baykonur Cosmodrome]

[Excerpt] Early in the morning of 20 July, the huge doors of the assembly-and-testing building at the Baykonur Cosmodrome rolled open. A rocket was moved slowly to the launch pad, accompanied by those who had prepared it for the flight.

The state commission met on the evening of 19 July in the conference room of the "Kosmonavt" hotel and gave final approval of the makeup of the crews. There were no surprises. As had been planned since the beginning of the preparations, the commander of the primary crew is Lieutenant Colonel A. Viktorenko, the flight engineer is Hero of the Soviet Union A. Aleksandrov, and the cosmonaut-researcher is Syrian Air Force Lieutenant Colonel Mohammed Faris. The commander of the backup crew is Lieutenant Colonel A. Solovyev, the flight engineer is two-time Hero of the Soviet Union V. Savinykh, and the cosmonaut-researcher is Syrian Lieutenant Colonel Munir Habib.

All of the crew members appeared together for a press conference that was held that evening. The Syrian pilots sat side by side in the middle. They are from the same unit, and also the same squadron. Both graduated from the military flight school in Aleppo.

In their squadron, Munir Habib conducted classes on aerodynamics, and Mohammed Faris on navigation. The air brigade in which they served is the best one in the Syrian Air Force.

On the morning of 22 July, the Baykonur steppe will be lit up by a fiery glow, and the rocket will roar into space.

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'MIR' COSMONAUTS PREPARE TO RECEIVE SOVIET-SYRIAN CREW

Leningrad LENINGRADSKAYA PRAVDA in Russian 22 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 21 July. The long flight of Yuriy Romanenko and Aleksandr Laveykin is continuing. Today the cosmonauts began their working day, which is their 166th, at 0900 hours Moscow time, and they will work until midnight.

The crew of the "Mir" manned complex today is doing work to prepare and test scientific instruments for joint research that is to be done in line with the program of the Soviet-Syrian mission. The launching of the spaceship "Soyuz TM-3" with two cosmonauts of the Soviet Union and a cosmonaut of the Syrian Arab Republic will take place on 22 July 1987.

Biological studies using the units called "Rost," "Fiton" and "Svetblok" are continuing on board the "Mir" complex. The purpose of these studies is to obtain information about the development of different plants in conditions of microgravitation. During the day the cosmonauts also will conduct visual observations and take photographs of various regions of the territory of our country.

According to telemetry data and reports from orbit, the work on board the complex is proceeding in line with the designated mission program.

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LAUNCH OF 'SOYUZ TM-3' WITH SOVIET-SYRIAN CREW

Moscow SOVETSKAYA ROSSIYA in Russian 23 Jul 87 p 1

[TASS Report]

[Text] On 22 July 1987 at 0559 hours Moscow time, the spaceship "Soyuz TM-3" was launched from the Soviet Union.

The ship is manned by an international crew: Aleksandr Viktorenko, the ship's commander; Hero of the Soviet Union and pilot-cosmonaut of the USSR Aleksandr Aleksandrov, the flight engineer; and Mohammed Faris, cosmonaut researcher, who is a citizen of the Syrian Arab Republic.

The mission program calls for the "Soyuz TM-3" ship to dock with the "Mir" manned complex, and for the Soviet-Syrian crew to conduct scientific-technical studies and experiments on it, together with cosmonauts Yuriy Romanenko and Aleksandr Laveykin, who have been working in near-Earth orbit since 6 February 1987.

The mission of the Soviet-Syrian crew is being carried out in line with an agreement between the governments of the Soviet Union and the Syrian Arab Republic.

Cosmonauts Viktorenko, Aleksandrov and Faris are feeling well.

The docking of the "Soyuz TM-3" ship with the "Mir" orbiting complex is scheduled for 24 July.

(A photograph of the three "Soyuz TM-3" cosmonauts in their space suits is given.)

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BIOSKETCHES OF 'SOYUZ TM-3' COSMONAUTS

Moscow SOVETSKAYA ROSSIYA in Russian 23 Jul 87 p 1

[Text] Aleksandr Stepanovich Viktorenko was born on 29 March 1947, in the village of Olginka, Sergeyevskiy Rayon, in North Kazakhstan Oblast.

After graduating in 1969 from the Orenburg Higher Military Aviation School for Pilots imeni Polbin, he served in the Air Force. During the time of his flight duty he mastered 10 types of aircraft. He has the qualifications "Military Pilot 1st Class" and "Test-Pilot 3d Class."

A.S. Viktorenko has been a member of the Communist Party of the Soviet Union since 1968.

Aleksandr Stepanovich was enrolled in the cosmonaut contingent in 1978. He has passed the complete course of training for space flights on the "Soyuz T" and "Soyuz TM" ships and the "Salyut" and "Mir" orbiting stations.

Hero of the Soviet Union, pilot-cosmonaut of the USSR Aleksandr Pavlovich Aleksandrov was born on 20 February 1943 in Moscow.

After completing service in the Soviet Army, A.P. Aleksandrov went to work at a design bureau in 1964.

In 1969 he graduated from the evening school of the Moscow Higher Technical School imeni Bauman.

He has taken part in the development of spacecraft control systems.

A.P. Aleksandrov has been a member of the Communist Party of the Soviet Union since 1970.

He has been in the contingent of cosmonauts since 1978.

Aleksandr Pavlovich made his first space flight as the flight engineer of the orbiting complex "Soyuz T-9"--"Salyut-7" in 1983.

Mohammed Ahmed Faris, a citizen of the Syrian Arab Republic, was born on 26 May 1951 in the city of Aleppo.

After graduating in 1973 from a military flight school, he served in air units of the air force of the Syrian Arab Republic.

M.A. Faris has been a member of the Arab Socialist Reconstruction Party since 1973.

In 1985 Lieutenant Colonel Mohammed Ahmed Faris began training at the Cosmonaut Training Center imeni Gagarin. He has passed the complete course of training for flights on the "Soyuz TM" spaceship and the "Mir" orbiting complex.

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'SOYUZ TM-3' COSMONAUTS PREPARE FOR DOCKING

Moscow PRAVDA in Russian 24 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 23 July. As of 1100 hours the "Soyuz TM-3" spaceship, which is manned by a Soviet-Syrian crew consisting of Aleksandr Viktorenko, Aleksandr Aleksandrov and Mohammed Faris, had completed 20 orbits around Earth.

In line with the mission program, the cosmonauts have checked the airtightness of the spaceship, conducted a test of the rendezvous and docking apparatus, and checked the condition of onboard systems. For forming a working orbit, several maneuvers have been executed in order for the ship to rendezvous with the "Mir" manned complex.

At the present time the parameters of the "Soyuz TM-3" ship's trajectory of movement are: maximum distance from Earth's surface--304 kilometers; minimum distance from Earth's surface--249 kilometers; period of revolution--89.9 minutes; inclination--51.6 degrees.

The working day on board the "Mir" manned complex began today with medical monitoring examinations of the cosmonauts. They Yuriy Romanenko and Aleksandr Laveykin continued preparing scientific instruments and equipment for upcoming work that will [be] done with the international crew.

According to reports from orbit and telemetry data, the flight of the "Soyuz TM-3" spaceship and the "Mir" complex is proceeding according to the designated program.

Cosmonauts Romanenko, Laveykin, Viktorenko, Aleksandrov and Faris are feeling well.

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'SOYUZ TM-3' DOCKS WITH 'MIR' COMPLEX

Moscow IZVESTIYA in Russian 25 Jul 87 p 1

[TASS Report]

[Text] On 24 July at 0731 hours Moscow time, the "Soyuz TM-3" spaceship docked with the "Mir" scientific research complex. An international crew consisting of four Soviet cosmonauts, Yuriy Romanenko, Aleksandr Laveykin, Aleksandr Viktorenko and Aleksandr Aleksandrov, and a Syrian cosmonaut, Mohammed Faris, has started to work in near-Earth orbit.

The mission's scientific program, which was prepared by scientists of the Soviet Union and Syria, is scheduled for six days. It includes photographing of the territory of the Syrian Arab Republic in the interests of various branches of the country's economy, and study of the upper layers of the atmosphere. In line with the program of space materials science, experiments are planned for the purpose of further studying processes of mass- and heat-transfer and of obtaining crystals with improved characteristics. Medical studies also will be performed, for the purpose of obtaining data on the influence of space flight factors on the human organism.

After the joint research is completed, there will be a partial replacement of the main crew of the manned complex. Cosmonauts Aleksandr Viktorenko, Aleksandr Laveykin and Mohammed Faris will return to Earth in the "Soyuz TM-2" spaceship, and Yuriy Romanenko and Aleksandr Aleksandrov will continue work in near-Earth orbit.

The mission of cosmonauts of the Soviet Union and Syria demonstrates clearly the close cooperation of the two fraternal countries in the cause of peaceful exploration of space.

Cosmonauts Romanenko, Laveykin, Viktorenko, Aleksandrov and Faris are feeling well.

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MANNED MISSION HIGHLIGHTS

EXPERIMENT PROGRAM, DECISION TO RETURN COSMONAUT LAVEYKIN

Moscow PRAVDA in Russian 26 Jul 87 p 2

[TASS Report]

[Text] Flight Contro. Center, 25 July. The Soviet-Syrian crew consisting of Yuriy Romanenko, Aleksandr Laveykin, Aleksandr Viktorenko, Aleksandr Aleksandrov and Mohammed Faris is working for the second day on board the "Mir" manned complex.

Today's program of joint work calls for geophysical and biotechnological experiments and medical research.

When the complex flew over the Syrian Arab Republic, an experiment called "Yefrat" (Euphrates, was conducted. In the course of it, the cosmonauts carried out a series of visual observations, photography and spectrometry of the country's territory. The information that was obtained will be used for studying agroindustrial resources, prospecting for minerals, research in the field of geology and hydrology, and also for monitoring pollution of the atmosphere and of coastal waters.

For the purpose of further study of the physics of the upper atmosphere and the ionosphere and for perfecting mathematical models of them, an experiment called "Bosra" is being conducted with highly sensitive instrumentation which was developed by Soviet and Syrian specialists.

Today a television hook-up was organized between space and Damascus. In the course of this television communication, President Hafez Asad of the Syrian Arab Republic spoke with the international crew of the "Mir" complex. He gave his greetings to the cosmonauts and wished them a successful completion of their mission.

Mohammed Faris underwent a medical examination which consisted of evaluating by means of electrocardiography the condition of his cardiovascular system during the stage of adaptation to zero gravity.

As was reported earlier, there will be a partial replacement of the primary crew of the manned complex when the program of joint research is completed. In the course of the long mission, thorough medical studies of cosmonaut

Aleksandr Laveykin have revealed certain peculiarities of the reaction of his cardiovascular system during tests with dosed physical exertion; these peculiarities have not been reflected negatively in his general physical condition and fitness to work. Nevertheless, due to difficulties with forecasting their possible development as the mission proceeds, the decision has been made to have Aleksandr Laveykin return to Earth together with cosmonauts Aleksandr Viktorenko and Mohammed Faris in the "Soyuz TM-2" spaceship. Yuriy Romanenko and Aleksandr Aleksandrov will continue working in near-Earth orbit.

According to telemetry data and reports from orbit, the flight of the "Mir" scientific research complex is proceeding normally.

The international Soviet-Syrian crew is working smoothly and in good spirits.

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COMMENTS ON MATERIALS EXPERIMENTS ON SOVIET-SYRIAN MISSION

Moscow PRAVDA in Russian 26 Jul 87 p 6

[Article by Ye. Nelepo]

[Abstract] The article records comments of two scientists who helped to plan materials-science experiments that were to be conducted during the stay of the Soviet-Syrian crew on board the "Mir" orbiting complex. The director of the Syrian scientific program for the mission is Bassami Massarami. He noted that he and L. Regel, head of the laboratory of space materials science of the USSR Academy of Sciences' Institute of Space Research, are both graduates of Moscow State University's school of physics. Regel is identified as one of the developers of the "Kristallizator" unit on the "Mir" complex. This unit was to be used for two materials-science experiments of the Soviet-Syrian crew. It is noted that as many as 19 different specimens, from glass to semiconductor materials, can be processed in the "Kristallizator" at the same time. This microprocessor-controlled unit maintains a constant relationship of temperatures and pressures and other parameters at the crystallization front, for periods lasting from several hours to several days. Temperature stability in the range of up to 1,000 degrees is ensured by five heating elements in the unit's furnace, and individual temperature and pressure conditions and rate of movement through the unit are maintained for each separate specimen.

Another experiment which is called "Palmira" was to involve growing of large numbers of tiny crystals from aqueous solutions. The apparatus prepared for the experiment consisted of two medical syringes connected by a plastic tube with a clamp from a dropper. The syringes were filled with solutions of different concentration on Earth, and in space the clamp would be opened and the solutions mixed by pushing down the plungers of the syringes. The superpure solutions were prepared using nuclear filters that were made in academician G. Flerov's laboratory of nuclear reactions at the Joint Institute for Nuclear Research.

It is mentioned that part of the materials brought back to Earth are to be turned over to Damascus University and to Syria's Higher Committee for Scientific Affairs.

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EXPERIMENTS CONTINUE ABOARD 'MIR' COMPLEX

Moscow IZVESTIYA in Russian 27 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 26 July. Cosmonauts Yuriy Romanenko, Aleksandr Laveykin, Aleksandr Viktorenko, Aleksandr Aleksandrov and Mohammed Faris are working jointly for the third day on board the orbiting complex "Mir."

Today the international crew will make several more series of measurement in line with the program of the "Bosra" experiment. Results of these studies will make it possible to obtain new scientific information on physical processes taking place in the upper layers of the atmosphere and ionosphere and to forecast their condition more precisely.

A Soviet-Syrian experiment called "Kasyun" is being conducted with the "Kristallizator" apparatus. The purpose of this experiment is to study features of crystallization processes of metal alloys in zero gravity. An aluminum-nickel alloy is being used as a model material.

Experiments aimed at electrophoretic purification and separation of various biologically active substances have begun. With a unit called "Ruchyey," the cosmonauts will purify several lots of interferon obtained by genetic engineering and of an anti-influenza preparation. Active microorganisms which produce a feed antibiotic for the needs of livestock raising are to be isolated, using a unit called "Svetlana."

During the first days of its stay on board the "Mir" complex, the crew of the visiting expedition carried out a substantial amount of medical research, results of which have demonstrated that the process of adaptation to weightlessness by Aleksandr Viktorenko, Aleksandr Aleksandrov and Mohammed Faris is proceeding normally.

The joint Soviet-Syrian mission is continuing.

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BIOTECHNICAL, MATERIALS EXPERIMENTS ABOARD 'MIR'

Moscow MOSKOVSKAYA PRAVDA in Russian 28 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 27 July. The latest workday of Yuriy Romanenko, Aleksandr Laveykin, Aleksandr Viktorenko, Aleksandr Aleksandrov and Mohammed Faris began at 0900 hours Moscow time.

Today the crew carried out one more series of photography and spectrometry of Syrian Arab Republic territory. Information obtained in the course of this work will be used in various branches of the country's science and economy.

In line with medical monitoring plans, the crew of the visiting expedition conducted an experiment called "Ballisto." Parameters of the cardiovascular system in conditions of space flight were determined in the course of this experiment.

Biotechnology experiments with the "Svetlana" and "Ruchyey" units are continuing. One distinctive feature of the "Ruchyey" unit is its higher productivity, which is achieved by virtue of the fact that the process of electrophoretic purification of source substances is accomplished in a layer of moving liquid.

Plans call for performing a technological experiment called "Afamiya" with the "Kristallizator" apparatus. The purpose of this experiment is to obtain single crystals of the semiconductor material gallium antimonide with improved characteristics, in conditions of extremely small gravitation.

At the end of the working day, the international crew will hold an onboard press conference for Soviet and foreign journalists who are covering this mission.

According to telemetry data and reports from orbit, the flight of the scientific research complex "Mir" is proceeding normally.

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COMMENTARY ON 'BOSRA' ATMOSPHERIC EXPERIMENT

Moscow IZVESTIYA in Russian 28 Jul 87 p 3

[Article by V. Konovalov, special correspondent at the Flight Control Center]

[Abstract] The article reports on geophysical, medical-biological and electrophoresis experiments which were being conducted during the stay of the Soviet-Syrian crew on board the orbiting station "Mir."

Particular attention is devoted to the program and methods of the geophysical experiment "Bosra," which had been in progress since 25 July. It is explained that the purpose of this experiment is to study dynamics of the Earth's atmosphere at altitudes of 200-400 kilometers, where the orbits of manned spacecraft lie. In particular, the cosmonauts were studying effects produced by solar radiation on components of the upper atmosphere, including changes in the kinetic energy of neutral atoms. Spectroscopic observations were being made of atomic hydrogen, whose luminescence becomes more intense during geomagnetic storms. The global distribution of temperatures of neutral atoms in the upper atmosphere also was to be studied, using a special electron-optical instrument. It is said to be equipped with miniature cooling devices which allow precise measurements to be made while the space station is on the dark side of the Earth. Results of this study are to be employed in experimental testing and refining of mathematical models for geophysical forecasting.

Mention is made of an experiment called "Kontrast" which had been performed for the purpose of studying the behavior of the human visual apparatus during the period of adaption to weightlessness.

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COMMENTARY ON MATERIAL EXPERIMENT, COSMONAUT DIET

Moscow TRUD in Russian 28 Jul 87 p 1

[Article by V.Golovachev, special correspondent at the Flight Control Center]

[Excerpt] For four days, an international collective of five cosmonauts has been working on board the orbiting complex beyond the Earth. Their program is a very full one, and a series of interesting experiments is conducted every day.

One of the materials used in the "Palmira" experiment is a substance bearing the recondite name of hydroxylapatite. Microcrystals of this substance are a basic component of bone and dental tissue. It is very difficult to obtain this material for dental prosthetics artificially, since its three-dimensional structure and crystalline lattice itself must meet very rigid requirements. And yet the problem of obtaining a substitute for bone and dental tissue is a very enticing one. This substitute would retain all the properties of the natural material and would not be rejected by the organism. If the Soviet-Syrian experiment that is being conducted with the "Palmira" unit proves successful, production of such an extremely valuable material for dentists' offices can be organized in future space factories.

On the "Mir" station, a crew can warm up not only food products in aluminum dispenser tubes but also canned meat and bakery products.

The assortment of foodstuffs on board "Mir" is rather diverse, including up to 70 items: meat, dairy and bakery products, confectionery, fruit, juices, beverages and seasonings. In contrast to earlier missions, this wide selection has made it possible to switch to a six-day menu and raise the calorific value of cosmonauts' rations of 3,100 kilocalories, which is a substantial increase as compared with the first space flights. This is natural, since cosmonauts are now subject to greater physical exertion (conditioning exercises with the stationary bicycle and running track, not to mention egresses into open space), and the duration of missions has also increased.

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EXPERIMENTS STUDY COSMONAUTS' CARDIAC ADAPTATION

Moscow KOMSOMOLSKAYA PRAVDA in Russian 28 Jul 87 p 3

[Article by S. Leskov, special correspondent at Flight Control Center]

[Excerpt] On board the orbiting complex "Mir"--"Kvant"--"Soyuz TM-2"--"Soyuz TM-3," five cosmonauts are working on an extensive program of scientific research.

Medical-biological studies hold a special place in the research program. Seven such experiments in all have been prepared. Most of them are familiar from previous missions, but a statistical set of results is extremely important in space exploration. There is not enough data as yet to construct a precise model of mechanisms of human adaptation in conditions of weightlessness, which will be indispensable in co monautics of the future.

We discussed this with Doctor of Medical Sciences Anatoliy Dmitriyevich Yegorov, deputy flight director in charge of medical support and a full member of the International Astronautics Academy. This scientist noted that the experiments "Ballisto" and "Adaptatsiya" are of particular interest, in his opinion. The purpose of "Ballisto" is to study contractile capabilities of the heart with the aid of a special piezoelectric accelerometer instrument. Up to now, only longitudinal (head-to-feet) pulses have been measured in space, but sensors will now be installed in three different planes of the body in turn. This will provide data on the spatial distribution of heart contraction energy.

The "Adaptatsiya" experiment is based on recording indicators of cardiac activity in a manner that is somewhat unusual, during the acute period of adaptation to zero gravity. This period occupies just about a week and is very convenient for research by visiting expeditions in particular.

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COMMENTS ON BIOTECHNOLOGY, ASTRONOMICAL EQUIPMENT ABOARD 'MIR' COMPLEX

Moscow PRAVDA in Russian 29 Jul 87 p 6

[Article by A. Tarasov, special correspondent at Flight Control Center]

[Abstract] The article summarizes conversations between personnel of the Flight Control Center and members of the primary and visiting crews on board the orbiting station "Mir." The cosmonauts told about equipment that they were using in biotechnology, materials-science and adaption research and in astronomical observations.

The units "Svetlana" and "Ruchyey" and spectrometers called "Vedma" and MKS-M were among this equipment. The "Svetlana" is intended for separating, on a semi-industrial scale, active microorganisms which produce a feed antibiotic for farm animals. The "Ruchyey" is used to obtain human antiviral interferon and other preparations of high purity. Interferon, for example, is purified by a process in which a stream of solution is directed across an electric field. This process is said to be a new one on space stations. Interferon purified in space is to be turned over to scientists of the USSR Academy of Sciences' Institute of Bioorganic Chemistry imeni Shemyakin. Scientists of the Crimea and Leningrad reportedly plan to produce test lots of antiserums and diagnostic preparations from an anti-influenza preparation purified in the "Ruchyey."

The "Vedma," an X-ray telescope-spectrometer, was developed by West German scientists for the "Kvant" module. This instrument was being used in observations of charged-particle radiation is super-powerful magnetic fields of neutron stars. Aleksandr Aleksandrov recalled that he and cosmonaut Vladimir Lyakhov had put the MKS-M into operation on "Salyut-7" in 1983. This spectrometer, which was developed in East Germany, was said to be operating reliably on "Mir."

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COSMONAUT LAVEYKIN CRITICIZES RELIABILITY OF RESEARCH EQUIPMENT

Moscow TRUD in Russian 29 Jul 87 p 4

[Article by V. Golovachev, special correspondent at the Flight Control Center]

[Abstract] The article is a report of a press conference which the Soviet and Syrian cosmonauts on board the orbiting station "Mir" held for Soviet and foreign journalists. The cosmonauts commented on advantages of international cooperation in the preparation and conduct of space missions, and on research which was being conducted during the Soviet-Syrian crew's stay on board "Mir."

Cosmonaut Aleksandr Laveykin praised the performance of the multichannel spectrometer MKS-M, which was developed in East Germany. Asked if he had any suggestions for designers of Soviet research equipment for space stations, Laveykin replied: "We ask that designers pay more attention to questions of reliability. It is very annoying when minor malfunctions and defects are discovered in research equipment during work. We eliminate them ourselves, of course, but then time is lost. We would also like to have more apparatus that operates in the automatic and semiautomatic modes. Then more experiments could be conducted simultaneously. The crew's work efficiency would be heightened."

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SOVIET-SYRIAN CREW CONCLUDING RESEARCH PROGRAM ABOARD 'MIR' COMPLEX

Moscow PRAVDA in Russian 29 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 28 July. The international crew consisting of Yuriy Romanenko, Aleksandr Laveykin, Aleksandr Viktorenko, Aleksandr Aleksandrov and Mohammed Faris is continuing joint experiments on board the orbiting complex "Mir."

Today the cosmonauts are carrying out the final series of studies in the field of upper-atmosphere and ionosphere physics with the aid of the highly sensitive apparatus "Bosra," which was developed by Soviet and Syrian specialists.

Experiments for purifying the latest lot of an anti-influenza preparation are being conducted with the electrophoretic unit "Ruchyey."

One more cycle of visual and instrument observations of territory of the Syrian Arab Republic has been performed for the purpose of obtaining information on natural resources of this country and detecting pollution of the atmosphere around major industrial centers.

An experiment called "Polyarizatsiya" (polarization) has been performed in the interest of further perfecting methods and equipment for heightening the effectiveness of scientific research from space, and for the purpose of solving a number of navigational problems.

In the course of the day, the crew of the visiting expedition will conduct medical observations for the purpose of evaluating contrast sensitivity of vision and determining the functional state of the cardiovascular system during physical exertion.

The planned program of joint Soviet-Syrian research is being carried out successfully.

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COSMONAUT LAVEYKIN CRITICIZES RELIABILITY OF RESEARCH EQUIPMENT

Moscow TRUD in Russian 29 Jul 87 p 4

[Article by V. Golovachev, special correspondent at the Flight Control Center]

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COSMONAUTS PREPARE FOR RETURN IN 'SOYUZ TM-2'

Moscow MOSKOVSKAYA PRAVDA in Russian 30 Jul 87 p 1

[TASS Report]

[Text] Flight Control Center, 29 July. Yuriy Romanenko, Aleksandr Laveykin, Aleksandr Viktorenko, Aleksandr Aleksandrov and Mohammed Faris are completing joint work on board the orbiting complex "Mir."

In the morning, while flying over the Syrian Arab Republic, the cosmonauts carried out the final series of geophysical studies in line with the program of the "Yevfrat" experiment.

One more cycle of electrophoretic separation of biologically active substances of high purity is being conducted today with the "Svetlana" unit.

The technological experiment "Afamiya," which was prepared by Soviet and Syrian specialists, is nearing completion. The purpose of this experiment is to obtain single crystals of the semiconductor material gallium arsenide in conditions of extremely small gravitation.

Preparations have begun for the descent of the spaceship "Soyuz TM-2" from orbit. Aleksandr Viktorenko, Aleksandr Laveykin and Mohammed Faris will return to Earth tomorrow in this ship. The cosmonauts are moving documents, cassettes with exposed motion-picture and photographic film, and biological specimens in containers into the spaceship's reentry vehicle. Materials from research performed in line with the program of the Soviet-Syrian mission and during prolonged work by Yuriy Romanenko and Aleksandr Laveykin will be delivered to Earth.

According to telemetry data and reports from orbit, the flight of the orbiting scientific research complex "Mir" is proceeding normally.

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COSMONAUTS RETURN TO EARTH IN 'SOYUZ TM-2'

Moscow VECHERNYAYA MOSKVA in Russian 30 Jul 87 p 1

[TASS Report]

[Excerpt] After completing a program of joint research and experiments on board the manned complex "Mir," an international crew consisting of Aleksandr Viktorenko, Aleksandr Laveykin, and Mohammed Faris, a citizen of the Syrian Arab Republic, returned to Earth on 30 July 1987 at 0505 hours Moscow time. Yuriy Romanenko and Aleksandr Aleksandrov are continuing their mission on board the scientific research complex "Mir."

The reentry vehicle of the spaceship "Soyuz TM-2" made a landing in the prescribed area of the Soviet Union's territory, 140 kilometers northeast of the city of Arkalyk.

Cosmonauts Viktorenko, Laveykin and Faris were feeling well after landing.

On board the manned complex "Mir," the international crew carried out in its entirety a program of joint research and experiments that are of great scientific and economic importance. This program was prepared by scientists and specialists of the Soviet Union and Syria.

Visual and instrument observations and photography of Syria's territory and coastal waters were carried out for the purpose of research of this country's natural resources and study of the environment. A large amount of information was obtained on physical processes in the upper layers of the Earth's atmosphere and the ionosphere.

Over the course of the entire mission, cosmonauts Yuriy Romanenko, Aleksandr Laveykin, Aleksandr Viktorenko, Aleksandr Aleksandrov and Mohammed Faris performed on a high professional level and with complete mutual understanding.

The orbital mission of Soviet and Syrian cosmonauts that has been successfully completed is an important new step on the path of many-sided cooperation which is constantly developing between the Soviet Union and the Syrian Arab Republic.

(A photograph is given showing the reentry vehicle of "Soyuz TM-2" descending on a parachute.)

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COMMENTS ON 'SOYUZ' REENTRY PROCEDURE, INTERFERON EXPERIMENT

Moscow SOVETSKAYA ROSSIYA in Russian 31 Jul 87 pp 1, 6

[Article by Aleksandr Nemov, special correspondent at the Flight Control Center]

[Abstract] The article reports on activities at the Flight Control Center (TsUP) during the "Soyuz TM-2" crew's return to Earth from the orbiting station "Mir." Specialists at the center are quoted in regard to results of biotechnology and medical-biological experiments which were performed on board the station during the stay of the Soviet-Syrian crew, as well as procedures which were used to orient the station in space while experiments were in progress.

Doctor of Technical Sciences V. Pouchkayev, head of TsUP's ballistic service, related that special measures were taken to conserve fuel during experiments employing equipment of the "Kvant" module. These experiments necessitate constant correction of the orbiting complex's position, Pouchkayev explained. It was therefore proposed that such correction be accomplished by means of gyrodynes powered by the station's solar batteries. Pouchkayev commented also on the accuracy of the procedure used to land the reentry vehicle of the spaceship "Soyuz TM-2" in the prescribed area on Earth. This procedure calls for the ship's braking engine to operate for 208 seconds precisely, reducing the ship's speed by 115.2 meters per second. Even if an error of 5 meters per second occurs, the reentry vehicle will land within a few hundred kilometers of the specified point, according to Pouchkayev. He mentioned that a special system has been developed for placing a vehicle into the specified landing area if an error of this magnitude occurs. Use of this system increases g-loads on the vehicle's occupants from a force of 3 to a force of 11, however.

O. Mitichkin related that in the course of an experiment with the "Ruchyey" unit, the cosmonauts separated an interferon preparation into two components with different colors--white and yellow. They are believed to be superpure interferon and impurities, respectively. Refrigerated test tubes containing these substances were placed in special foam-plastic containers and delivered to Earth by the crew of "Soyuz TM-2," for further study.

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NO PATHOLOGICAL CHANGES IN LAVEYKIN'S CARDIAC ACTIVITY

Moscow PRAVDA in Russian 1 Aug 87 p 2

[Article by P. Pelekhov]

[Excerpt] The cosmonauts had already arrived at Baykonur by noon. All three walked down the boarding ramp of their airplane. In the evening, Laveykin declared that he would go to dinner by himself, that nothing had to be brought to him in his room, as though he were ill, and that he missed having something solid under his feet while in zero gravity. But all attempts at 'rebellion' were suppressed.

A meeting with the crew on the second day after a landing is an inviolable tradition of Baykonur.

A. Laveykin had spent almost half a year in zero gravity. Frankly, we journalists were a little surprised that a collective meeting, so to speak, was permitted only with A. Viktorenko and Mohammed Faris. We were told that we would meet Laveykin later, in his room. To jump ahead, let me say that we expected to find him sitting, if not lying down. Nothing of the sort. He met us standing up, not showing off at all, and said half seriously that he was surprised to be receiving such close care from the physicians. But there was reason for 'close care.' As has been reported, his return to Earth was occasioned by the fact that certain deviations had been discovered in cardiograms received from orbit. N.M. Mukharlyamov, a representative of a cardiology center, was specially invited to Baykonur to investigate them here, on Earth. He and I.K. Tarasov, a physician of the Cosmonaut Training Center, noted that no pathological changes were discovered in Laveykin's cardiac activity. If it were not for the cardiograms from orbit, one would feel absolutely that the cosmonaut had simply returned from his prolonged flight with no problems whatsoever.

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TASS REPORTS REDOCKING MANEUVER OF 'SOYUZ TM-3'

Moscow PRAVDA in Russian 1 Aug 87 p 1

[TASS Report]

[Text] Flight Control Center, 31 July. The space mission of Yuriy Romanenko and Aleksandr Aleksandrov is continuing. In line with the designated flight program, the spaceship "Soyuz TM-3" was undocked from the astrophysical module "Kvant" today and docked with the base block on the side of its adapter module.

The rearranging of the orbiting complex "Mir" was carried out for the purpose of ensuring further transport operations for supplying the complex with fuel and various cargo items, using automatic cargo ships of the "Progress" series.

Before the undocking, the cosmonauts went into the transport spaceship and closed the transfer hatches. The "Soyuz TM-3" ship separated from the "Kvant" module at 0328 hours Moscow time.

On commands from the Flight Control Center, the orbiting complex was rotated 180 degrees. The crew docked the spaceship with the base block at 0348 hours.

The onboard systems of the spacecraft functioned normally at all stages of the maneuver.

Yuriy Romanenko and Aleksandr Aleksandrov are feeling well.

The work in near-Earth orbit is continuing.

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COSMONAUTS CONDUCT SUPERNOVA OBSERVATIONS, BOTANY EXPERIMENTS

Moscow TRUD in Russian 5 Aug 87 p 1

[TASS Report]

[Text] Flight Control Center, 4 August. Cosmonauts Yuriy Romanenko and Aleksandr Aleksandrov are continuing planned research on board the orbiting complex "Mir."

During the days just past, another two series of observations of the supernova in the Large Magellanic Cloud were made with the aid of the international observatory "Rentgen," which is installed on the astrophysical module "Kvant."

Experiments aimed at studying possibilities for cultivating higher plants in conditions of space flight are continuing. In particular, three-month-old seedlings of cedar trees and chlorophytum are objects of study in these experiments. These plants were delivered into orbit by the Soviet-Syrian crew in the spaceship "Soyuz TM-3."

The crew's agenda for today calls for routine maintenance of research apparatus and individual onboard systems of the complex, for medical-biological and biochemical studies, and for engaging in physical exercises.

Yuriy Romanenko and Aleksandr Aleksandrov are feeling well.

The flight of the orbiting complex "Mir" is proceeding normally.

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MANNED MISSION HIGHLIGHTS

LAUNCH OF 'PROGRESS-31' CARGO SHIP

Moscow TRUD in Russian 5 Aug 87 p 1

[Text] In line with the program of further work of the orbiting scientific research complex "Mir," an unmanned cargo spaceship, "Progress-31," was launched from the Soviet Union on 4 August 1987, at 0044 hours Moscow time.

The purpose of the launching of the spaceship is to deliver materials which become depleted and various cargo items to the manned complex "Mir."

The "Progress-31" ship was placed into an orbit with the parameters: maximum distance from the surface of Earth--269 kilometers; minimum distance from the surface of Earth--193 kilometers; period of revolution--88.8 minutes; inclination--51.6 degrees.

According to telemetry information, the onboard systems of the unmanned cargo ship are functioning normally.

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'PROGRESS-31' DOCKS WITH 'MIR' COMPLEX

Moscow IZVESTIYA in Russian 7 Aug 87 p 2

[Text] The cargo spaceship "Progress-31" docked with the manned complex "Mir" on 6 August 1987, at 0228 hours Moscow time.

The mutual search, rendezvousing, approach and docking were carried out with the aid of onboard automation. These procedures were monitored by the Flight Control Center interacting with the ground command-and-measurement complex, and also by cosmonauts Romanenko and Aleksandrov.

The "Progress-31" ship docked with the complex at the end where the "Kvant" module is located. Fuel for the station's combined engine unit, foodstuffs, water, equipment and apparatus, and also mail were delivered into orbit.

According to telemetry data and the crew's reports, the onboard systems of the manned complex "Mir" are functioning normally.

Yuriy Romanenko and Aleksandr Aleksandrov are feeling well.

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COSMONAUTS BEGIN UNLOADING 'PROGRESS-31'

Moscow PRAVDA in Russian 8 Aug 87 p 3

[TASS Report]

[Text] Flight Control Center, 7 August. The flight of the scientific research complex "Mir," which is manned by Yuriy Romanenko and Aleksandr Aleksandrov, is continuing. The crew's commander has begun the seventh month of his tour of duty in space.

As has been reported, the latest unmanned transport spaceship arrived at the orbiting complex on 6 August. After checking the seal of the docking mechanism, the cosmonauts opened the transfer hatches and began unloading the spaceship. They are placing equipment that it delivered in compartments of the base block and the astrophysical module.

In addition to work with the "Progress-31" spaceship, the crew is performing a number of routine preventive-maintenance operations on the station today. Plans call also for a medical examination aimed at evaluating and forecasting the condition of the cardiovascular system in conditions of space flight, and two hours of conditioning exercises with the stationary bicycle and the running track.

According to telemetry information and reports by the cosmonauts, the flight of the orbiting complex "Mir" is proceeding normally.

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VISION EXPERIMENT, ASTROPHYSICAL STUDIES ABOARD 'MIR'

Moscow IZVESTIYA in Russian 12 Aug 87 p 1

[TASS Report]

[Text] Flight Control Center, 11 August. Yuriy Romanenko and Aleksandr Aleksandrov are continuing planned work on board the orbiting complex "Mir."

During the days just past, the cosmonauts were engaged chiefly in unloading the unmanned transport spaceship "Progress-31." They have carried a large portion of the delivered equipment into compartments of the complex and arranged it there, and they have pumped water from tanks of the spaceship into tanks of the station.

Today's agenda calls for the crew to prepare scientific apparatus for upcoming research. In particular, they are to load stationary cameras with film and check optical instruments.

The cosmonauts will also conduct an experiment for evaluating parameters of spectral sensitivity of vision in conditions of flight. This experiment is being performed with the aid of a color atlas and a special test chart.

Astrophysical studies employing the international orbiting observatory "Rentgen" are continuing. X-ray telescopes installed on the specialized module "Kvant" were again aimed at the supernova in the Large Magellanic Cloud, beginning 10 August.

According to results of telemetry and the crew's reports, the flight of the manned complex "Mir" is proceeding normally.

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COSMONAUTS WORK WITH 'KORUND' UNIT, CONTINUE ASTROPHYSICAL OBSERVATIONS

Moscow IZVESTIYA in Russian 15 Aug 87 p 4

[TASS Report]

[Text] Flight Control Center, 14 August. The latest work week of Yuriy Romanenko and Aleksandr Aleksandrov on board the orbiting complex "Mir" is ending.

In line with the program of geophysical research, the cosmonauts carried out several series of photography of individual areas of land surface and the waters of the world's oceans du[illegible]ng the days just past.

Today the crew began work with the unit "Korund," which is intended for producing various semiconductor materials with improved characteristics in conditions of extremely small gravitation. A microcomputer which is a component of this unit allows space materials-science experiments to be performed in the automatic mode, following a prescribed program.

Astrophysical studies using the orbiting international observatory "Rentgen," which is installed on the "Kvant" module, are continuing. Sources of X-radiation [illegible] the constellation Hercules are now objects of observations.

A medical examination of the crew is planned for today. The condition of the cosmonauts' cardiovascular systems is to be evaluated, their vision is to be checked, and body masses are to be determined, in particular.

The flight is proceeding normally.

Yuriy Romanenko and Aleksandr Aleksandrov are feeling well.

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COSMONAUTS CONDUCT PULSAR, SUPERNOVA OBSERVATIONS

Moscow PRAVDA in Russian 19 Aug 87 p 1

[TASS Report]

[Text] Flight Control Center, 18 August. The space mission of Yuriy Romanenko, crew commander of the orbiting complex "Mir," has been in progress for 193 days, and flight engineer Aleksandr Aleksandrov is completing his fourth week of work in orbit.

A substantial place in the complex's flight program is reserved for astrophysical studies, which are being performed with the aid of the orbiting international observatory "Rentgen." Several periods of observations of various stellar systems are being conducted every day. Studies of an X-ray pulsar in the constellation Hercules have been continued, in particular.

On 13 August instruments of the observatory recorded a powerful gamma-ray burst of space origin.

The constellation Cygnus has been selected as an object of study today, and X-ray telescopes will again be aimed at the supernova in the Large Magellanic Cloud from 19 to 21 August.

Power gyrostabilizers installed on the module "Kvant" ensure highly precise orientation of the orbiting complex and stabilization of the complex for prolonged periods of time while astrophysical experiments are in progress. The crew is monitoring prescribed conditions with the aid of instruments and feeding corrections into an onboard computer when necessary.

According to the cosmonauts' reports and telemetry data, all systems of the scientific research complex "Mir" are functioning normally.

The work in orbit is continuing.

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COSMONAUTS TO PERFORM PHOTOGRAPHY OF EARTH'S SURFACE, CONTINUE ASTROPHYSICAL OBSERVATIONS

Moscow PRAVDA in Russian 22 Aug 87 p 1

[Text] The orbital flight of Yuriy Romanenko and Aleksandr Laveykin is continuing. [as published]

A substantial portion of the crew's working time is reserved for geophysical studies, the purpose of which is to gather information on natural resources of the Earth and to study processes taking place in the atmosphere and near-Earth space.

The cosmonauts have conducted one more melt in the "Korund" unit, and they have performed a number of technical experiments.

The latest series of photography of land surface and waters of the world's oceans is planned for today, as is a medical examination of the crew.

Astrophysical experiments employing the international orbiting observatory "Rentgen" are continuing. Measurements which are needed for compiling X-ray maps of individual sections of the sky will be made with the aid of the observatory's telescopes during the days immediately ahead.

The flight of the manned complex "Mir" is proceeding normally.

Yuriy Romanenko and Aleksandr Aleksandrov are feeling well.

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COSMONAUTS PERFORM UV OBSERVATIONS WITH 'GLAZAR' TELESCOPE

Moscow IZVESTIYA in Russian 26 Aug 87 p 1

[TASS Report]

[Text] Flight Control Center, 25 August. Cosmonauts Yuriy Romanenko and Aleksandr Aleksandrov are continuing their work on board the orbiting complex "Mir."

Research employing scientific apparatus of the specialized astrophysical module "Kvant" occupies a substantial place in the flight program. With the aid of the international orbiting observatory "Rentgen," a large volume of observations of various sources of X-radiation has lately been conducted, and extensive information has been obtained on the supernova that flared up in the Large Magellanic Cloud in February of this year.

Experiments for studying astrophysical objects in the ultraviolet wave band are continuing. The purpose of these studies, which are being performed with the aid of the ultraviolet telescope "Glazar," is to obtain data on short-wave length radiation of galaxies. The cosmonauts conducted a series of photography of sources in the constellations Grus and Pavo yesterday, and areas near the stars Alpha Pavonis and Alpha Eridani have been selected as objects for observations today.

Today's agenda for the crew calls also for photographing individual areas of land surface and the waters of the world's oceans, in line with the program for study of Earth natural resources.

Yuriy Romanenko and Aleksandr Aleksandrov are feeling well.

The flight is proceeding normally.

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COSMONAUTS CONTINUE ASTROPHYSICAL OBSERVATIONS

Moscow IZVESTIYA in Russian 29 Aug 87 p 1

[TASS Report]

[Text] Flight Control Center, 28 August. The latest week of Yuriy Romanenko's and Aleksandr Aleksandrov's space mission is ending.

The crew's program of work during the days just past included geophysical and astrophysical research, and routine maintenance of individual onboard systems of the complex.

A series of experiments using the telescope "Glazar" has been conducted. Sources of ultraviolet radiation in the constellations Andromeda and Piscis Austrinus were objects of study on 26 August, and areas near Alpha Pavonis and Alpha Eridani were selected as areas for photographing today.

Information on the supernova in the Large Magellanic Cloud continues to be received from the "Mir" complex. The supernova was again in the lenses of the international orbiting observatory "Rentgen" yesterday. This astrophysical object was studied simultaneously with the aid of the ultraviolet telescope "Glazar."

Tomorrow will be a day of rest for Yuriy Romanenko and Aleksandr Aleksandrov.

According to results of medical monitoring, both cosmonauts are feeling well. The commander's pulse rate is 64 beats a minute and the flight engineer's is 62 beats a minute, and their arterial pressures are 115 over 70 and 110 over 70 millimeters of mercury, respectively.

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ASTRONOMY OBSERVATIONS, MAINTENANCE WORK ABOARD 'MIR'

Moscow PRAVDA in Russian 2 Sep 87 p 1

[TASS Report]

[Text] Flight Control Center, 1 September. The flight of the orbiting complex "Mir," which is manned by Yuriy Romanenko and Aleksandr Aleksandrov, is continuing.

Within the framework of the international program of astrophysical research, several series of experiments employing X-ray telescopes of the specialized module "Kvant" were performed from 29 to 31 August. Observations were made of the supernova in the Large Magellanic Cloud and of a neutron source in the constellation Cygnus.

In addition to conducting scientific research, the crew has been periodically performing routine operations involving replacement of individual components of onboard systems of the complex and installation of additional equipment and instruments. In line with the plan for further equipping of the station, the cosmonauts are to finish installing one more hydraulic-pump unit of the temperature control system and check its functioning today.

According to telemetry data and reports of the crew, the work in near-Earth orbit is proceeding in accordance with the designated program.

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MEDICAL MONITORING OF COSMONAUTS, OBSERVATIONS CONTINUE

Moscow IZVESTIYA in Russian 5 Sep 87 p 2

[TASS Report]

[Text] Flight Control Center, 4 September. Yuriy Romanenko's and Aleksandr Aleksandrov's space tour of duty on board the scientific research complex "Mir" is continuing.

For the purpose of evaluating the condition of the cosmonauts' health and forecasting their working fitness, medical monitoring is being performed regularly in the course of the prolonged mission in orbit.

The next series of photography within the framework of the program for study of Earth natural resources is planned following a medical examination.

Astrophysical experiments using the orbiting observatory "Rentgen" are continuing. Observations of an X-ray pulsar in the constellation Hercules were conducted during the past three days.

According to telemetry data and the cosmonauts' reports, the onboard systems of the orbiting complex "Mir" are functioning normally.

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COSMONAUTS CONTINUE EARTH PHOTOGRAPHY, TECHNICAL EXPERIMENTS

Moscow IZVESTIYA in Russian 9 Sep 87 p 1

[TASS Report]

[Text] Flight Control Center, 8 September. The space tour of Yuriy Romanenko, commander of the crew of the scientific research complex "Mir," has lasted 215 days, and Aleksandr Aleksandrov, the flight engineer, is completing his seventh week of work in orbit.

Today the crew is performing astrophysical and technical experiments and photographing individual areas of the Earth's surface in line with the program for research of natural resources and study of the environment. Plans call also for two hours of physical conditioning exercises, which are mandatory on a prolonged space mission.

On 7 and 8 September several series of studies of X-ray sources in the center of our galaxy were made with the aid of the orbiting observatory "Rentgen." Observations of the supernova in the Large Magellanic Cloud will be continued dur[illegible]g the coming days.

According to results of telemetric measurements and the cosmonauts' reports, the onboard systems of the manned complex "Mir" are functioning normally.

The work in orbit is continuing.

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COSMONAUTS PHOTOGRAPH WITH KATE-140 CAMERA, OBSERVE ATMOSPHERE

Moscow PRAVDA in Russian 12 Sep 87 p 1

[TASS Report]

[Text] Flight Control Center, 11 September. The latest work week of Yuriy Romanenko and Aleksandr Aleksandrov on board the orbiting complex "Mir" is ending.

Within the framework of the international program "Rentgen," studies of a source of radiation with an unusually hard X-ray spectrum were conducted during the days just past with the aid of the orbiting observatory which is installed on the "Kvant" module. The object of these observations is in the vicinity of the supernova in the Large Magellanic Cloud.

A substantial portion of the crew's working time is reserved for geophysical studies today. With the aid of the stationary camera KATE-140, the cosmonauts are performing a series of photographing of the territory of the Soviet Union particularly Kazakhstan and the Central Black-Earth Zone of Russia. Experiments are planned for the purpose of determining optical characteristics of the atmosphere by the method of evaluating changes in the brightness of stars as they set beyond the Earth's horizon and intersect the aerosol layer.

The day's agenda calls also for routine maintenance of individual onboard systems, a television report, and engaging in physical exercises.

Tomorrow will be a day of rest for Yuriy Romanenko and Aleksandr Aleksandrov.

According to the cosmonauts' reports and telemetry data, the flight of the scientific research complex "Mir" is proceeding normally.

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MANNED MISSION HIGHLIGHTS

COSMONAUTS BEGIN REFUELING OPERATIONS

Moscow PRAVDA in Russian 16 Sep 87 p 1

[TASS Report]

[Text] Flight Control Center, 15 September. The flight of Yuriy Romanenko and Aleksandr Aleksandrov is continuing on board the orbiting complex "Mir."

Geophysical studies have occupied a substantial place in the crew's work during the past days. In accordance with assignments from scientists and specialists of various branches of the country's economy, the cosmonauts are photographing the Earth's surface, and they are performing experiments for further study of the atmosphere and for determining spectral and optical characteristics of the atmosphere. Plans for today call for conducting several series of photographing of the central part of the Soviet Union's European territory and of North Kazakhstan, in particular.

Astrophysical studies using the orbiting observatory "Rentgen" are continuing. The observatory's telescopes are now aimed at the supernova in the Large Magellanic Cloud.

Refilling of tanks of the base block's combined engine assembly with fuel and an oxidizing agent delivered into orbit by the cargo spaceship "Progress-31" has begun. Carried out in advance were preparatory operations for checking the airtightness of fuel lines and pumping compressed nitrogen out of the fuel tanks.

According to the cosmonauts' reports and telemetry data, the onboard systems of the scientific research complex "Mir" are functioning normally.

The work in orbit is proceeding in line with the designated program.

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COSMONAUTS CALIBRATE X-RAY DETECTORS OF 'RENTGEN' TELESCOPE

Moscow PRAVDA in Russian 19 Sep 87 p 1

[TASS Report]

[Text] Flight Control Center, 18 September. The latest work week of Yuriy Romanenko and Aleksandr Aleksandrov on board the orbiting complex "Mir" is ending.

The crew was engaged chiefly in geophysical research during the days just past. Southern regions of the Soviet Union's territory were photographed, particularly the Ukraine, the Volga Basin and Kazakhstan. The cosmonauts also conducted the latest medical examination.

Work with the orbiting observatory "Rentgen" is continuing within the framework of the international program of astrophysical research. Telescopes of this observatory which are installed on the "Kvant" module are aimed at the Crab Nebula today. The purpose of these experiments is to calibrate detectors of the telescopes. Such calibration is necessary for precise determination of the spectrum of X-radiation of the supernova in the Large Magellanic Cloud. This radiation was recorded for the first time from the "Mir" complex on 10 August 1987.

In line with the plan for work with the unmanned transport spaceship "Progress-31," the cosmonauts have begun loading it with depleted equipment.

Yuriy Romanenko and Aleksandr Aleksandrov are feeling well.

The flight is proceeding normally.

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'PROGRESS-31' UNDOCKED, OBSERVATIONS OF X-RAYS FROM SUPERNOVA

Moscow PRAVDA in Russian 23 Sep 87 p 1

[TASS Report]

[Text] Flight Control Center, 22 September. The flight of the scientific research complex "Mir," which is manned by Yuriy Romanenko and Aleksandr Aleksandrov, is continuing.

As has been reported, X-ray telescopes installed on the "Kvant" module first recorded as unusually hard spectrum of X-radiation in the vicinity of the supernova in the Large Magellanic Cloud on 10 August 1987. Subsequent observations performed with highly precise orientation of the orbiting complex have confirmed that the supernova is the source of this X-radiation. Observations of the evolution of the spectrum of this most interesting astrophysical object will be continued after detectors of the telescopes are calibrated.

More than 300 periods of observations of sources of X-radiation, including 115 periods of observation of the supernova, have been conducted in all from the orbiting complex during the period beginning in June of this year. Scientific information obtained through telemetry channels on a real-time scale is being processed at the USSR Academy of Sciences' Institute of Space Research and then transmitted to research centers of Great Britain, the Netherlands, the Federal Republic of Germany and the European Space Agency.

Following completion of the program of joint flight, the unmanned transport spaceship "Progress-31" was separated from the manned complex "Mir" today at 0358 hours Moscow time.

All of the operations that were planned for this period, including unloading the spaceship, refilling tanks of the base block with fuel and an oxidizing agent and transferring drinking water, were fully completed. A correction of the complex's trajectory of movement was executed with the aid of the cargo ship's engine.

The process of undocking was monitored by specialists of the Control Center and cosmonauts Romanenko and Aleksandrov.

According to the crew's reports and telemetry data, the flight is proceeding normally.

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DESTRUCTIVE REENTRY OF 'PROGRESS-31' CARGO SHIP

Moscow PRAVDA in Russian 24 Sep 87 p 1

[TASS Report]

[Text] Flight Control Center, 23 September. The flight of the unmanned transport spaceship "Progress-31," which was launched into near-Earth orbit on 4 August 1987, has ended.

Today the cargo ship was oriented in space on commands from the Control Center, and its engine was then fired at 0422 hours Moscow time. As a result of braking, the "Progress-31" spaceship went into a descending trajectory, entered the dense layers of the atmosphere, and ceased to exist.

Yuriy Romanenko and Aleksandr Aleksandrov are continuing their work on board the "Mir" complex. Today's agenda calls for routine maintenance of individual systems and preparation of scientific apparatus for upcoming research and experiments.

Both cosmonauts are feeling well.

The flight is proceeding normally.

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'PROGRESS-32' CARGO SHIP LAUNCHED

Moscow IZVESTIYA in Russian 25 Sep 87 p 2

[Text] In line with the program for further operation of the orbiting scientific research complex "Mir," an unmanned cargo spaceship, "Progress-32," was launched from the Soviet Union on 24 September 1987, at 0344 hours Moscow time.

The purpose of the launching of the spaceship is to deliver materials which become depleted and various cargo items to the manned complex "Mir."

The "Progress-32" ship was placed into an orbit with the parameters: maximum distance from the surface of Earth--267 kilometers; minimum distance from the surface of Earth--193 kilometers; period of revolution--88.8 minutes; inclination--51.6 degrees.

According to telemetry data, the onboard systems of the unmanned cargo ship are functioning normally.

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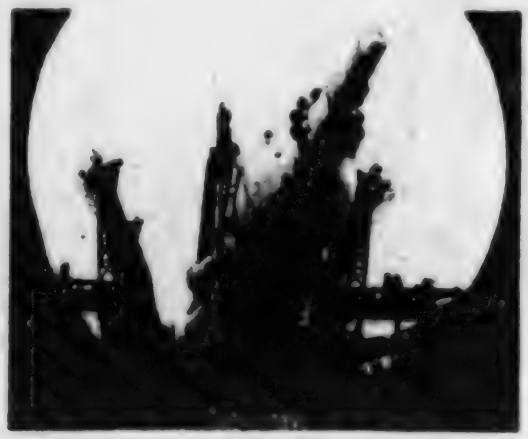
COMMENTS ON SOYUZ T-8 LAUNCH FAILURE, COSMONAUT RESCUE SYSTEM

Moscow KRASNAYA ZVEZDA in Russian 30 May 87 p 4

[Article is a narration by Cosmonaut Vladimir Titov, with supplementary comments by Krasnaya Zvezda correspondent Col. M. Rebrov; article is titled "Testing," with subhead "In Orbits of Courage"; first four paragraphs make up sidebar in source, with photo]

[Text] Among the Letters to the Editor are a great number of letters in which readers request that we explain the ERS, the emergency rescue system for a spacecraft's crew. They ask, How often must it be used?

Take a look at the photograph of the booster. Its nose cone turns into a unique spike. A "skirt" of solid-fuel engines is fastened to the cone. This, plus the automatic equipment and the lattice-like fins attached to the fairing, makes up the ERS. In the event of an emergency during the start or in the initial leg of the flight, the system triggers the descent vehicle and the orbiting module, pulling them up and to the side. They then separate, and the descent vehicle parachutes to Earth.



On September 26, 1983, a booster emergency occurred during preparations for the launch of a Soyuz spacecraft. The crew--Vladimir Titov and Gennadiy Strekalov --were forced to try the rescue system out. That has been the only launch emergency during the entire history of manned space flight.

Here is what Vladimir Titov, who took part in the events, says about it. His story is supplemented with comments by our correspondent Col. M. Rebrov.

V. TITOV: Five months had passed since that April day when our crew--Gennadiy Strekalov, Sasha Serebrov, and I--blasted off aboard the Soyuz T-8. Gennadiy and I were again at Baikonur, and we busied ourselves with prelaunch preparations that lasted from morning to late in the night: documentation, confinement, outfitting, training, and "contact" with the medical personnel. The steady rhythm of the long succession of days and hours is slowly but inexorably approaching that point beyond which a totally different world begins. That very border, between Earth and space, that separates the customary "weightiness" from the strange and, for the most part, still enigmatic weightlessness.

We left for the launch complex when it was still daylight. We dressed in the fitting-and-examination block. Jokes were exchanged through the glass with the journalists. The report of the State Commission was read. Then there was the bus ride of several minutes.

There she was--our rocket. When you looked at her from the side, she seemed a bundle of nerves, too.

We walked to the elevator without rushing: the space suit is comfortable in space, but on Earth it fetters movement somewhat and makes one's step heavier.

Above, from the boarding platform, the rocket seems much taller. One wants to look around again at the black, hilly steppe that, like us, is full of expectation. It is quiet. The silence is broken only by the commands over the loudspeaker system. The vent valves "gasp" white vaporous clouds of supercooled oxygen.

The escorts help me get into the descent vehicle and into my seat. Gennadiy is already harnessed in, because he was seated first.

The hatch cover is closed. Now we must again check to see that everything is in order.

We switch on the communications channels. "Okeany!" [Oceans!], bursts Kizim and Solovyev. The two-hour countdown mark is announced.

We begin to check the basic systems of the spacecraft. We do everything by instruction, in accordance with the items listed in the log book. We report to the bunker what we have done.

M. REBROV: The planned launch time was 23 hours 37 minutes 49 seconds. It had been hot during the day--25-27 degrees--but now the temperature fell to +10. The breeze was warm but biting. From time to time, the gusts reach 12 meters and higher. There are few people on the viewing platform; they will begin to come up later. It is us, the journalists, who arrive earlier than the others. We also leave before the others, to get to the telephones and the teletypes sooner.

Prestart operations go according to the program. The crew is often shown on the television, and the conversations with them are heard over the loud speakers. Everything is in order.

Sasha Ivanchenkov has arrived. There is much talk about the business at hand, about the orbital station Mir, which must take the place of the "seven." I ask, "Do you intend to make a third flight, or is that it for you?"

"I hope [to go on a third]," he answers.

We spoke of the tedious hours of waiting. Sasha said that theoretically the time could be shortened.

V. TITOV: The 90-minute countdown mark is announced. We continue to check the systems, and I rarely say a word to Gennadiy. Rarely because we have mastered everything, and a glance suffices for understanding each other.

The check is completed, and we have some time left over. Gennadiy suddenly recalled our first flight. He concluded philosophically: "On the front they say that a shell never hits the same crater twice." He said that and then grinned. "It is not going to hit," I responded, and then I added: "Tighten your sling."

M. REBROV: The athletics commissar Ivan Borisenko arrived. He began to talk about the first start of "Okeany." An information clerk interrupted him: "We are getting a telemetry reading. The pulse of the crew is 80 and 72."

Radio communications were smooth: short questions, short answers. Once in a while, a clarification. From onboard, the crew spoke with monosyllables, without emotion, without exclamations. The conversation is particularly businesslike. Borisenko goes over to the "representatives" [firmach:] who had come to watch the launch, and I decided to take a look at the control center of the search-and-rescue service. There, on the maps of the region that were laid out, was the launch path and locations of the rescue units. And there also, the conversations were businesslike. I thought, Better not distract them.

V. TITOV: "Okeany, do you want music onboard?" they asked through the console.

Before I could answer, Gennadiy blurted out, "Give it to us." I like music, too, but now just plain silence would be better: slam the log book shut, get away from all those numbers, and be quiet. "Modern rhythms" resounded in our headsets. Let it go. It was relaxing, too.

M. REBROV: The countdown was down to 30 minutes. Everything was on schedule, everything according to plan. I could get a cup of coffee. There would be practically no one in the cafeteria. I went there. I began to count how many launches I had seen, and lost count. One thing I knew for sure: all of them were unique.

V. TITOV: Whether the prelaunch time had flown or plodded, did it have anything to do with the many operations that had to be performed? That is difficult to say. There, in the spacecraft one could sometimes cover a span of several years in a matter of several short seconds. One could return to a past so palpable that it was as if it had been only yesterday. But you could not give yourself up to your recollections: the operators were checking this and recommending that...

We took care of our own business, mentally reviewing what would occur with the spacecraft's and the booster's systems. And again, the waiting. The pauses did become shorter though. If only we could get past that final point faster.

Besides those involuntary excursions into the past, you also live in the future, acting out the launch, the entry into orbit...

When I flew for the first time, the waiting was different: I wanted very much to feel, to experience in reality what I had heard so much about from our guys. Now everything was simpler and more peaceful.

M. REBROV: The countdown was at 15 minutes. Over the loudspeaker came the words, "The ERS is set." Then the parameters of the spacecraft and the booster were checked. Nearby, everyone burst out laughing, in response to a joke the commander, Volodya Titov, had told. But I did not catch what he said. I thought, We lose our concentration over a long period of time, he cannot...

V. TITOV: Just before my first launch, my expectations were illusive: what lay ahead was enigmatic, unusual. The second time represented an anticipation of my entry into weightlessness, a concept that I understood. At first there would be the deceptive lightness, the hands and feet would lose their responsiveness. Inside, everything would be suspended, a suffocating lump would rise in your throat, and your head would feel as it were filled with lead. I never had any problems with weightlessness. I never had the uneasy thought, How long is this going to last? I simply recalled the advice of my comrades who had flown and of the instructors: "Do not make a fuss, be calm, do not make any quick movements, especially your head."

They usually advise you not to think about your sensations, but about work, and everything will stabilize. And that is how it turned out.

M. REBROV: The countdown was down to one minute!

"Switch to start!" sounded the metallic voice in the loudspeakers. And then the command was echoed.

I looked at my watch.

"Purging!"

"Broaching!" [protyazhka]

"Three minutes 20 seconds to start!"

"Pressurization of tanks under way! Two minutes 30 seconds to start!"

I count to myself, as if to speed up the time. At this point, the umbilical tower is supposed to move away. At a count of 25, when the tower still has not moved, a red-and-yellow flame suddenly appears. It is not the usual flame. Clouds of black smoke begin to envelope the rocket. The engines cannot be heard, even though a rumble usually begins with the appearance

of the flame. It is growing! And now everything is almost silent. This is strange.

V. TITOV: The countdown of the final seconds is under way. We are waiting for the slight tremor and for the rumble below. That signals that the engines are beginning to operate. A second, and another...

What is normally expected did not happen. Not even after still more time. It felt to me as if the rocket was swaying. I thought, "The wind is jerking us. Now the tanks are beginning to be pressurized."

A slightly vibrating wave passed over us. I do not know why, but I did not like this "trembling." I thought of the wind again. The vibration was beginning to subside, and after 2-3 seconds, it calmed down. I glanced at my watch. It is time!

But then a second wave of vibrations started. It grew quickly. And suddenly there was a terrible jerk...

M. REBROV: The white column of a rocket, illuminated by spotlights, began to, as it were, collapse. Or at least it seemed that way. Smoke that was yellow, red, black, and orange boiled up almost to the very top.

Then something jerked in the darkness. Was it the rocket? No, it was still in place. The night, shredded by the bright light, pressed heavily upon the rocket with its flashing blackness. The boundary between light and shadow sparked and blistered.

"The ERS has been triggered," I heard someone say behind me.

V. TITOV: The thought "An explosion" raced through my head like lightning. But I managed not to give in to it. "If it were an explosion, then..." And then I had another thought: "We did not make it again." And by then, I was calm. "Yes, we did not make it."

M. REBROV: The spotlights swept the sky looking for the jettisoned spacecraft. Then the parachute flashed. "That means everything worked. The automatic equipment did not let us down. But what about the crew?" Several tense seconds later, somewhere off to the side, a cloud of dust rose from the steppe. It was the soft-landing system working. "How about that, guys? How are they?"

V. TITOV: The muffled crack returned me to reality. It was the pyrotechnic cartridges exploding. For a fraction of a second I was numb, but then I understood--the nose fairing had been jettisoned.

The thought "This is it!" burned in my head. And then, "What do you mean this is it?" I interrupted myself. "Something is going wrong. It is going wrong, but there was no explosion. Otherwise...That means there is nothing terribly wrong. There is a malfunction, somewhere..."

I must remember the details of everything that is happening. That is the most important thing right now. And I must dictate as much of it as possible into the recorder.

We hear Kizim. But we already understand that the emergeency rescue system has been triggered.

By now everything is going smoothly. The parachute has been deployed, and we are beginning to rock gently. We look at each other in silence. We land below. Through the left porthole, we can see the burning launch. We talk about what has happened.

"Okeany!" It is Kizim again. "Be calm, guys. Everything is OK. They will be getting to you now and helping you out of the craft...Do not worry, you will fly next time!"

That last transmission drew a smile. The rapid kaleidoscope of thoughts stopped. We had, as it were, come back down to Earth. We had so anticipated that flight, dreamed about it, worked, trained--and all, it seemed, had been for nothing.

M. REBROV: The flame had diminished, but it began to spark more intensely. The lights of a search-and-rescue helicopter glittered in the black sky. It rather unexpectedly emerged from the darkness and landed. It was the rescuers delivering the crew to the airfield.

We returned to the hotel at daybreak. I dialed the editor's office, and the switchboard operator answered. I asked the operator to tell the editor-in-chief that the material would probably be delayed.

V. TITOV: Indeed, Yuriy Gagarin said: "All of us are researchers, and each of us is called upon to do something for the first time..." That is how it is. And that is how it will be: space, you see, is a road without end.

The emergency rescue system worked efficiently. And it once again convinced the developers and us, the cosmonauts, of the far-reaching possibilities of technology.

We are often asked, Was it frightening? I do not know what to answer. I never thought about it. That is the truth! Believe me, a cosmonaut never expects any emergency conditions, any serious failures or hitches. During training, we practice going through a multitude of hazardous, if not emergency, situations. We practice them so that we will be able to act in similar situations with a clear head and with competence. Just such an incident happened the night of September 26, 1983.

All this spanned just a few seconds. And those seconds were blanketed by an analysis of what had happened, so that not one detail would be unremarked, so that it would be easier for others to function...

M. REBROV: This event may seem like something that happened long ago. Vladimir Titov recalls it calmly and surely. He does not dramatize it or exaggerate. For the crew, it was a test, just part, perhaps, of their job. For me, though, the events of that night have not fallen silent. They have strengthened my sense of recognition of and respect for those who have devoted their lives to the exploration of space, to a task that is difficult and dangerous, but needed by us all.

CSO: 1866/98

CONFERENCE ON COSMIC RAYS OPENS IN MOSCOW

Moscow VECHERNYAYA MOSKVA in Russian 3 Aug 87 p 1

[Text] An international conference on cosmic rays will open at Moscow University during the second half of the day.

It is the 20th forum of its kind. This jubilee conference is being held during the year of the 75th anniversary of the discovery of cosmic radiation. About 800 specialists are taking part in it. Among them are eminent astrophysicists and scientists in the fields of physics of cosmic rays, elementary particles and plasma from the Soviet Union, the United States, Great Britain, France, Italy, the Federal Republic of Germany, India, Japan, China, Poland, Bulgaria, Hungary and other countries of the world.

The purpose of the present meeting is to single out the most promising directions and methods of research. In particular, the conference will discuss experimental data on the flare-up of a supernova in a Magellanic Cloud which occurred on 23 February 1987; models of particle acceleration in the magnetic fields of the giant planets Saturn and Jupiter and in interplanetary space; and other problems of tremendous scientific and practical importance.

The conference will last until 15 August.

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SPACE SCIENCES

COMMENTS BY SCIENTISTS AT COSMIC RAYS CONFERENCE

Moscow SOVETSKAYA ROSSIYA in Russian 8 Aug 87 p 3

[Article by A. Nemov]

[Excerpt] At the 20th International Conference on Cosmic Rays, which is now in progress in Moscow, scientists from 30 countries are discussing contemporary problems of this direction of science. Here is what some of these scientists had to say.

Professor G. Krymskiy, director of the Institute of Space-Physics Research and Aeronomy of the Yakutsk affiliate of the USSR Academy of Sciences' Siberian Branch: "A stream of high-energy electrons rushes toward us from the point where the solar wind comes in contact with our planet's magnetosphere. This phenomenon causes a good deal of trouble. With the aid of instruments installed on a satellite, we obtained data that have permitted fairly precise theoretical substantiation of this phenomenon. This will make it possible in the future to forecast the appearance of radio interference on the airwaves, and consequently to make intercontinental radio communication more reliable."

Professor G. Kocharov, head of the astrophysics department at the Physical-Technical Institute imeni Ioffe of the USSR Academy of Sciences' Leningrad Research Center: "We have managed to establish a number of parameters which are, so to speak, precursors of solar flare-ups. This makes short-term forecasting possible. On the basis of satellite data on solar activity, we can predict a flare-up 10-15 minutes before it begins. This is a very valuable result, considering the fact that bursts of solar plasma which complicate radiation conditions in near-Earth space present a hazard to cosmonauts in orbit. After learning of a flare-up soon enough, cosmonauts can return from open space to their spaceship."

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VLBI RESEARCH ON OH-MASER IN W33

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 13 No 5, May 87 (manuscript received 27 Nov 86) pp 399-405

[Article by V.Ye. Velikhov, D. Graham and P. Diamond, Space Research Institute, USSR Academy of Sciences, Moscow; Max Planck Radio Astronomy Institute (FRG)]

[Abstract] The OH maser source W33 was studied at a frequency 1665 MHz in left circular polarization. In the continuous radio emission there is an extended region surrounding the compact W33 MAIN, in which star formation actively transpires. In W33 there are several discrete IR sources coinciding with the youngest HII zones. There are two regions with intermediate velocities of 36 km/s (W33A) and 56 km/s (W33B). A detailed knowledge of the horizontal structure of W33A is necessary for research on the star formation process. W33A observations were made using the interferometers Yevpatoriya-Simeiz (September 1983 and April 1984), Simeiz-Pushchino (April 1984), Yevpatoriya-Pushchino (April 1984) and Effelsberg-Onsala (November 1984). The image was constructed using a model with several free parameters on the assumption that the source consists of a minimum number of components with a Gaussian spatial brightness distribution and that emission of no more than two components is received in each spectral channel. The spectral measurements revealed that the source spectrum consists of overlapping details with widths of about 2 kHz. The emission of the spectral lines is determined by several spatially separated regions. A map was constructed showing that the source is highly elongated and consists of six components which can be divided into three groups. The spectrum obtained in observations corresponds to the computed spectrum of the model. The brightest spectral details are emitted by the most compact regions in which T_B attains 5.10^{10}K. As a model it is possible to propose condensations near a recently forming hot star.

Figures 6; references 8: 2 Russian, 6 Western.

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CSO: 18660016

UDC 524.351-732

OBSERVATIONS OF GAMMA BURSTS FROM GBS 0526-66

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 13 No 5, May 87 (manuscript received 4 Nov 87) pp 406-413

[Article by S.V. Golenetskiy, R.L. Aptekar, Yu.A. Guryan, V.N. Ilinskiy and Ye.P. Mazets, Physical Technical Institute imeni A.F. Ioffe, USSR Academy of Sciences, Leningrad]

[Abstract] The extraordinary gamma burst of 5 March 1979 continues to be studied in detail. The burst GB 790305 began with a short, very strong initial impulse with a hard radiation component and an annihilation line. The initial impulse was followed by pulsating radiation characteristic of an X-ray pulsar and having a relatively soft spectrum. The most probable explanation of burst structure would be rotation of a neutron star with a period 8 ± 0.05 s. The object was observed repeatedly by the "Konus" apparatus on the "Venera" spacecraft (-11, -12, -13, -14) during the period 1979 - 1983. A noteworthy feature of the burst source, GBS 0526-66, is a series of recurrent bursts. During 687 days of observations 16 repeated bursts were observed (averaging one burst each 48 days). These 16 repeated bursts are listed in a table with the parameters of these events. New information has been collected which supplements this list. The strongest and most prolonged repeated burst was registered on 27 February 1982 at $0^h16^m41^s.2$ UT (the first of two bursts registered that day). The temporal structure and energy spectra of GB 820227a are discussed in detail. In contrast to GB 790305, these recurring bursts have no initial impulse with a hard radiation component. This evidently indicates a significant difference in the mechanism of generation of GB 790305 and the recurrent bursts. Although it has been postulated that GBS 0526-66 may coincide in the celestial sphere with a remnant of the supernova N49 in the Large Magellanic Cloud and there might be a physical identity of these two objects, this hypothesis is difficult to support, especially in explaining the energetics of the phenomenon. Figures 4; references 13: 2 Russian, 11 Western.

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SPACE SCIENCES

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FLARE DOUBLET: INTERPLANETARY AND GEOMAGNETIC EFFECTS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 27 No 2, Mar-Apr 87
(manuscript received 10 Apr 86) pp 201-205

[Article by K.G. Ivanov, N.V. Mikerina, P.P. Pavlov and A.F. Kharshiladze, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR Academy of Sciences]

[Abstract] The properties of interplanetary and geomagnetic disturbances are influenced by the interaction of magnetic clouds from flares. The interaction of such clouds is clearly manifested when a series of two flares (doublet) occurs. The exceptional flare doublet of 10 August 1979 afforded an opportunity for studying the behavior and consequences of such cloud interactions. The cloud-generating flares developed with an interval of 4.5 hours on the same meridian to the east of the Earth and in different active regions. The spatial positioning and temporal occurrence of these flares made interaction inevitable. The second cloud overtook the first and imparted some of its momentum to it, accelerating it in a radial direction and resulting in a westward displacement. In the resulting interplanetary and geomagnetic disturbances this was manifested in a more rapid arrival of the main bow shock (38 hours in comparison with the mean statistical time of 67±9 hours for isolated flares), an anomalous configuration of the main bow shock front and its low velocity, and the presence of a cold density increase and heating of magnetic cloud plasma. Each of these phenomena are described in detail. In the absence of such interaction no geomagnetic disturbance would have occurred or its characteristics would have been different. The unusual duration of the initial phase, its structure and variable intensity, as well as the great lag of the main phase and anomalous behavior of the AL index are evidence of existence of several interplanetary sources of the storm of 11-13 August 1979, interacting with one another. Figures 3; references 16: 8 Russian, 8 Western.

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UDC 550.388.2

TRAJECTORY SYNTHESIS OF IONOGRAMS IN PRESENCE OF ARTIFICIAL IONOSPHERIC INHOMOGENEITIES

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 27 No 2, Mar-Apr 87 (manuscript received 6 Jan 86) pp 217-221

[Article by N.P. Danilkin, D.S. Lukin and V.I. Stasevich, Moscow Physical Technical Institute; Applied Geophysics Institute, USSR State Committee for Hydrometeorology and Environmental Control]

[Abstract] Artificial modifications of the ionosphere, resulting in strong local electron concentrations, provide a possibility for routine detection and analysis of ionospheric inhomogeneities. Since these formations measure from 3-5 to several tens of kilometers and they develop in seconds or minutes, methods based on coherent and incoherent scattering of radio waves are inapplicable and radio sounding is preferable. The use of frequencies close to the plasma frequencies of a disturbance makes it possible to investigate structural details routinely, but the registered ionograms are intricate and it is very difficult to extract information on inhomogeneities. In order to overcome this difficulty an algorithm is proposed for the speedy computation of such ionograms, providing for the synthesis of ionograms registered when there are sharply expressed ionospheric gradients. In this case the ionogram is characterized not only by the usual vertical sounding trace, but also by elements formed by rays with nonvertical directions which were returned to the radiation point after being refracted on inhomogeneities. Separate consideration is given to inhomogeneities situated near the F-layer maximum and those situated considerably below it. In all cases the considered ionograms were registered when the source and receiver were at a single point. More complete and precise information on inhomogeneities can be obtained by using several receivers separated by an optimal distance. Calculations were made to determine these optimal distances under a number of differing circumstances. Figures 2; references: 4 Russian.

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UDC 533.951

ELECTROSTATIC VLF EMISSION DETERMINED FROM ROCKET AND SATELLITE EXPERIMENTS

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 27 No 2, Mar-Apr 87 (manuscript received 1 Sep 86) pp 270-273

[Article by N.I. Izhovkina and S.A. Pulinets, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR Academy of Sciences]

[Abstract] Data on VLF emission obtained in experiments on rockets and satellites are compared with computations for models of electrostatic and electromagnetic VLF emission. Emphasis is on measurements made in the ionosphere due to closeness between the conditions for making the described experiments and the "Araks" experiment. The joint examination of "Araks" data and data from geophysical rockets launched in Antarctica made it possible to clarify the mechanism of emission under natural ionospheric conditions. This body of data is reviewed. The problem of identifying the types of experimentally observed radiation is analyzed. In general, the nature of radiation can be determined from its attenuation in plasma. Short-wave electrostatic radiation attenuates rapidly in undisturbed plasma and therefore cannot be detected at a considerable distance from the source. Computations were made to determine the increments of electrostatic low-frequency radiation for the most unstable part of the spectrum for a spatially anisotropic velocity of distribution of the plasma electron component. References 13: 4 Russian, 9 Western.

5303/8309
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UDC 532.62-337:550.385.37

MONITORING OF Pc3 PULSATIONS IN SOLAR WIND AND AT EARTH BY INTERPLANETARY MAGNETIC FIELD

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 27 No 2, Mar-Apr 87
(manuscript received 6 Apr 86) pp 345-346

[Article by O.V. Bolshakova, V.A. Troitskaya and T.B. Rusakova, Borok Geophysical Observatory, Earth Physics Institute, USSR Academy of Sciences]

[Abstract] A study was made of Pc3-4 pulsations generated in the solar wind before the near-Earth bow shock front. Their relationship to parameters of the interplanetary magnetic field (IMF) was investigated and the observed patterns were compared with the period and amplitude of Pc3 by IMF strength and orientation known earlier for terrestrial pulsations. The terrestrial pulsations were analyzed using magnetograms for the longitudinally spaced middle-latitude stations Borok and Petropavlovsk and solar wind pulsations were analyzed using data from the ISEE satellite for September-October 1979. The generation of Pc3 pulsations in the solar wind which are observed simultaneously at the Earth occurs only in the subsolar part of the bow shock. An effort was made to ascertain the extent of this region. Analysis of these data revealed a considerable statistical difference in the properties and behavior of pulsations in the Pc3 range observed before the front of the near-Earth bow shock and at the Earth's surface. A coincidence of behaviors is observed only in a comparison of the properties of surface pulsations and waves generated in the solar wind in the subsolar region of the bow shock front in the range 0900-1300 LT. The linear dimensions of this region coincided with the extent of the region of generation of diffuse ions on the bow shock front as determined from satellite data. Figures 2; references 11: 3 Russian, 8 Western.

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DIPOLE COMPONENT OF RELICT RADIATION DETERMINED FROM 'RELIKT' EXPERIMENT DATA

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 13 No 3, Mar 87 (manuscript received 15 Aug 87) pp 163-166

[Article by I.A. Strukov, D.P. Skulachev, M.N. Boyarskiy and A.N. Tkachev, Space Research Institute, USSR Academy of Sciences, Moscow]

[Abstract] Measurements of the dipole anisotropy of relic radiation make it possible to determine solar system motion velocity. Such measurements were made by the "Prognoz-9" satellite during 1983-1984 during the "Relikt" experiment, which lasted about 8 months. During this time the entire celestial sphere was scanned once or more. The satellite carried a Dicke radiometer with two antennas: a reference antenna oriented along the axis of satellite rotation in a direction opposite the direction to the sun, and a measuring antenna oriented perpendicular to the axis. The celestial sphere was scanned during satellite rotation, each scan being formed over the course of about a week and consisting of 120 points, each in turn obtained by averaging about 5,000 independent observations. All the scans intersected at the poles of the ecliptic. The thermodynamic temperature of the dipole component was 3.16 ± 0.12 mK in the direction $\alpha = 11^h17^m\pm10^m$, $\delta = -7.5^\circ\pm2.5^\circ$, which corresponds to a velocity of motion of the observer relative to the relic background 350 ± 15 km/s with $T_{BG} = 2.73$ K. Combining the results obtained by P. Lubin, et al. (ASTROPHYS. J. (LETTERS), Vol 298, p L1, 1985) and D.J. Fixsen, et al. (PHYS. REV. LETTERS, Vol 50, p 620, 1983) with the results in this study gives: $T_D = 3.25\pm0.1$ mK, $\alpha = 11^h15^m\pm4^m$, $\delta = -8\pm1^\circ$. References 3: 1 Russian, 2 Western.

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UDC 524.8

NONEQUILIBRIUM IONIZATION OF PREGALACTIC PLASMA AND LESSENING OF RELIC RADIATION ANISOTROPY

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 13 No 3, Mar 87 (manuscript received 31 Mar 86) pp 167-173

[Article by P.D. Naselskiy and A.G. Polnarev, Space Research Institute, USSR Academy of Sciences, Moscow]

[Abstract] The present-day density ρ of matter in the universe should be approximately identical to the critical density $\rho_{cr} = 3H_0^2/8\pi G$ (H_0 is the Hubble constant, G is the gravitational constant), i.e. $\Omega = \rho/\rho_{cr} = 1$. Models with the cosmological constant for the time being make it possible to match the prediction $\Omega = 1$ with observational limitations on the density of the "hidden mass" using the Virial velocities of galaxies in clusters $\Omega_m \leqslant 0.3$. The age of the universe predicted within the framework of this model apparently agrees with the age scale of old globular clusters $t_{gc} > 1.5 \cdot 10^{10}$ years. All models with the cosmological constant (with $\Omega_m h_0 \leqslant 0.05$), like all models with $\Omega < 0.3$, however, meet with difficulties in explaining the low level of small-scale anisotropy of relic electromagnetic radiation. A possible way to eliminate these difficulties is proposed for models with $\Omega < 0.3$ and with $\Omega_m + \Omega_v = 1$. The observed high level of small-scale anisotropy with $\Omega < 0.3$ is attributable to two factors: slow increase in adiabatic density disturbances and the ionization regime of clearing the pregalactic plasma relative to relic radiation. Estimates are given which indicate the high efficiency of the mechanism of non-equilibrium ionization of pregalactic plasma as a factor responsible for lessening small-scale anisotropy of relic radiation. Figure 1; references 26: 15 Russian, 11 Western.

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SPACE SCIENCES

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UNUSUALLY STRONG DENSITY DECREASE IN NEAR-EARTH INTERPLANETARY PLASMA AND MAGNETICALLY QUIET DAY AS EFFECTS OF ISOLATED SOLAR FLARE

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 27 No 1, Jan-Feb 87
(manuscript received 17 Feb 86) pp 7-11

[Article by K.G. Ivanov and N.V. Mikerina, Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Institute, USSR Academy of Sciences]

[Abstract] A new property of an interplanetary-magnetospheric disturbance induced by an isolated flare is described in the example of the events following the flare of 26 July 1979. At that time there was a great variation in the density of interplanetary plasma near Earth, ranging from $\sim 10^2$ to 10^{-1} particles·cm^3; after a moderate magnetic disturbance there was a magnetically quiet day as a result of density decrease. Although a considerable decrease in particle density in the interplanetary medium is well established, until now the literature has indicated relatively moderate decreases, to $n \approx 1\text{-}2$ cm^{-3} and that these n decreases are accompanied by high velocities v; no distinction has been drawn between isolated flares and series of flares. This article gives a full analysis of the studied event, characterized by variation of the density of interplanetary plasma near the Earth after an isolated flare with a range of four orders of magnitude. Simultaneously with a decrease in velocity and temperature, exceedingly low values $n \approx 0.1\text{-}0.2$ cm^{-3} were attained. This variation can be interpreted as successive passage through the shock layer, magnetic cloud and trace of the magnetic cloud in the interplanetary medium. A world quiet day may occur after a geomagnetic disturbance as a result of rarefaction of the interplanetary medium after an isolated flare. Figures 3; references 18: 12 Russian, 6 Western.

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UDC 524.1:523.9:523.62-726

SOLAR COSMIC RAY PROPAGATION IN HIGH-VELOCITY SOLAR WIND STREAM

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 27 No 1, Jan-Feb 87
(manuscript received 8 Oct 85, after revision 8 Aug 86) pp 12-17

[Article by Ye. V. Kolomeyets and V.N. Sevostyanov, Kazakh State University]

[Abstract] A study was made of the propagation of solar cosmic rays (SCR) in the high-velocity solar wind. This involved a comparison of SCR propagating in the event of 17 December 1976, when corotating high-velocity streams were observed, and the event of 3 June 1967, when this phenomenon was not observed. The particle transfer equation was solved numerically for describing SCR propagation in these events. The equation for anisotropic diffusion of SCR, with allowance for convection and change in particle energy in interplanetary space, as well as the pertinent kinetic propagation equation, were solved numerically. These solutions and an analysis of experimental data were used in studying the influence of long-lived solar wind streams on the propagation of fast protons generated in solar flares. The analysis suggests that in the solar wind structure there are well-defined channels for the propagation of fast charged particles. These channels are associated with long-lived regions of interaction between streams with different velocities in which the motion of the charged component of SCR occurs with little scattering. This conclusion was based on a study of propagation of protons with energies of several MeV, but studies of protons with energies of several GeV (using neutron monitor data) give a similar result. An analysis of the frequency spectra of the intensity of interplanetary magnetic field fluctuations also indicates that there are channel structures in the interplanetary medium characterized by anisotropic conductivity of interplanetary space for the cosmic ray current. Figures 3; references 14: 7 Russian, 7 Western.

5303/8309
CSO: 18660078

UDC 550.388.2

LONGITUDINAL VARIATIONS OF EQUATORIAL IONOSPHERE DETERMINED FROM 'INTERCOSMOS-19' ARTIFICIAL EARTH SATELLITE DATA

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 27 No 1, Jan-Feb 87 (manuscript received 25 Mar 86) pp 142-144

[Article by N.A. Kochenova, Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Institute, USSR Academy of Sciences]

[Abstract] The work program for the ionospheric station aboard the "Intercosmos-19" artificial earth satellite was prepared in such a way that in the course of 24 hours it was possible to register a virtually complete picture of ionospheric longitudinal variations at the same local time (at identical geographical latitudes). The longitudinal variations of the equatorial ionosphere for daytime in summer in the northern hemisphere were analyzed. Series of meridional sections and f_0F2 charts for individual days revealed a great variability of the equatorial ionosphere along the Earth's surface and from day to day. Regions where the equatorial anomaly is quite well-expressed alternate with regions where it is expressed considerably more poorly or is absent. An f_0F2 analysis along the magnetic equator was made first for clarifying the pattern of this phenomenon. For this purpose a study was made of six quiet periods ($K_p \leqslant 3$) with different solar activities ($F_{10.7}$) and local time (LT) during the summer months of 1979-1980. The data from this satellite provided a global picture of the equatorial anomaly longitudinal variations. Comparison with the intensity of the equatorial electrojet confirmed that its variations can roughly explain the longitudinal variations of the equatorial anomaly in f_0F2. It is shown that there are stable longitudinal electron concentration variations at the F2 layer maximum which are associated with longitudinal variations of the entire equatorial ionosphere in the range of geomagnetic latitudes up to $\pm 40°$. There are stable longitudinal variations of vertical electrodynamic drift which determine these longitudinal variations. Figures 2; references 6: 2 Russian, 4 Western.

5303/8309
CSO: 18660078

UDC 521.134

LIMITATION OF SPACECRAFT ORBIT NEAR COLINEAR LIBRATION CENTER OF LIMITED ELLIPTICAL THREE BODY PROBLEM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 293 No 1, Mar 87 pp 55-58

[Article by P.Ye. Elyasberg and T.A. Timokhova, Institute of Space Research, USSR Academy of Sciences, Moscow]

[Abstract] The movement of a spacecraft in the gravitational field of two attracting bodies moving relative to each other in elliptical orbits with slight eccentricity is studied, assuming that the mass of the first body is greater than or equal to the mass of the second. If a limited orbit exists, it is shown that it can be found by solving systems of equations presented in the article. In practice the problem is solved approximately, analytically or numerically.

References 3: 2 Russian, 1 Western

6508/8309
CSO: 18660070

UDC 533.951.2

ABSORPTION OF CYCLOTRON RADIATION IN SKIN LAYER IN 'ARAKS' EXPERIMENT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 8 Jan 86) pp 216-222

[Article by N.I. Izhovkina, S.A. Pulinets and Ye.P. Trushkina]

[Abstract] Results are presented from calculations related to the heating of the electron component of the plasma by cyclotron radiation upon propagation of whistlers upward along a geomagnetic force tube in the area of the skin layer during the "Araks" experiment. The calculations indicate that the non-isothermal nature of the plasma resulting from heating of the electron component can cause breakup of whistlers and sonic oscillations. The delay time of bursts of wave radiation and electron fluxes is pauses between pulses with respect to the preceding electron pulse also indicates a need for more detailed calculations to determine the mechanism of propagation of waves and resonant particles in the skin layer area. VLF bursts in the pauses between electron pulses may be related to VLF-wave breakdown in the non-isothermal skin layer plasma.

References 12: 6 Russian, 6 Western

6508/8309
CSO: 18660087

SPACE SCIENCES

UDC 551.[illegible].035.2

ELECTRODYNAMICS OF MIDNIGHT SECTOR OF AURORAL OVAL IN PERIODS OF SLIGHT DISTURBANCE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol [illegible], No 2, Mar-Apr 87
(manuscript received 14 Mar 86) pp 223-234

[Article by E.M. Dubinin, P.L. Izraylevich, A.K. Kuzmin, N.S. Niklayeva, I.M. Podgornyy, A.N. Zaytsev and V.G. Petrov]

[Abstract] An analysis is presented of simultaneous measurements of electrical and magnetic fields, precipitation of particles and upper atmosphere glow aboard the Intercosmos Bulgaria 1300 satellite and of Earth-surface magnetograms from a chain of IZMIRAN stations in the midnight sector in the initial phase of development of a small substorm, in order to determine the electrodynamic structure of the auroral oval near the midnight meridian. The satellite was launched on 7 August 1981 in a near circular orbit of about 900 km altitude and 81.7° inclination. A three-layer structure of longitudinal currents was detected during quiet and slightly disturbed periods in the midnight sector. There was a significant increase in flux and mean energy of precipitated electrons in the area of the upward directed longitudinal electric current from the ionosphere. The distribution of the electric field in the area of two intense current layers was similar to the characteristic distribution E in the zones of longitudinal currents 1 and 2 of the morning sector of the auroral oval. The ionosphere acts as an electric load for the system of longitudinal currents in the midnight sector, generated in the magnetosphere. Ionospheric polarization is not required to explain the results obtained. A Hall current flows along layers of intense longitudinal current in the ionosphere. The center of the Western electrojet is located between zones 1 and 2 of the longitudinal currents, not coinciding with the area of maximum conductivity, nor with the area of maximum electric field.

Figures 7, references 20: Western

6508/8309
CSO: 1866008

UDC 551.521.6

AREA OF REDUCED ELECTRON CONCENTRATION IN TERRESTRIAL PLASMASPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 28 Mar 86) pp 235-242

[Article by V.P. Grigoreva and V.V. Pisareva]

[Abstract] During observations by the "Prognoz-5" satellite, as the subauroral and auroral latitudes of the Southern Hemisphere were approached, a sharp decrease was observed in the intensity of natural noise in the 50-500 KHz band, related to a decrease in electron concentration at these latitudes. The largest areas with reduced electron concentration observed during the June 1977 experiments were located near the Brazilian magnetic anomaly and in the interval of latitudes at $\pm 30^\circ$ from the equator, longitudes 100-240°E, near the geomagnetic equator, and in areas with a slight shift from the geomagnetic equator in the winter hemisphere. The most characteristic feature of the phenomenon observed was development of an area of reduced electron concentration in the plasmasphere on the night side of the Earth.

Figures 5, references 6: 4 Russian, 2 Western

6508/8309
CSO: 18660087

UDC 625.396.94

FLUCTUATIONS IN FREQUENCY OF COHERENT RADIO SIGNALS IN SOLAR PLASMA ACCORDING TO 'VENERA-15 and -16' DATA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87 (manuscript received 25 Aug 86) pp 243-250

[Article by N.A. Savich, S.L. Azarkh, A.S. Vyshlov, A.L. Gavrik, N.V. Laptev and A.S. Nabatov]

[Abstract] Results are presented from studies of fluctuations in adjusted frequency difference of coherent radio signals as they propagate through the solar plasma above the corona as measured by the "Venera-15 and -16" spacecraft orbiting Venus in May-July 1984. The mean square deviation in fluctuations of adjusted frequency difference was about 5 Hz at 6 solar radii, decreasing exponentially with increasing distance from the Sun with exponent $\beta = -1.9$. With increasing averaging time of the adjusted frequency difference τ, the mean square deviation decreased as $\tau^{-0.2}$. The fluctuation spectra can be approximated by an exponential function between 10^{-3} and 4 Hz with R not less than 20 solar radii. The spectral index at $4 \cdot 10^{-3}$ - 0.2 Hz is 0.65 $\pm$0.2 as the spacecraft moves behind the Sun, 0.5 $\pm$ 0.2 as the spacecraft emerges from behind the Sun.

Figures 4; References 12: 8 Russian, 4 Western

6508/8309
CSO: 18660087

UDC 535.24:523.42

DYNAMICS AND TURBULENCE OF SOLAR WIND IN AREA OF ITS FORMATION BASED ON RADIO TRANSMISSION DATA MEASURED WITH 'VENERA-15 and -16' SPACECRAFT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 1 Sep 86) pp 251-257

[Article by O.I. Yakovlev, A.I. Yefimov and S.N. Rubtsov]

[Abstract] Results are presented from radio transmission through the plasma near the Sun at centimeter and decimeter wavelengths conducted by the "Venera-15" and "Venera-16" spacecraft orbiting Venus in March-September 1984 during a period of moderate solar activity. The spacecraft transmitted coherent radio signals at 32 cm and 5 cm wavelength toward the Earth as Venus passed behind the Sun. The velocity of the solar wind was determined for distances of 5.5 to 100 solar radii. At 10-25 solar radii there is a regular singular area in which the parameters of the solar wind change sharply. The relationship between the spectral index and velocity of the heterogeneous plasma is investigated. The variation in corona expansion velocity as a function of solar activity is discussed.

Figures 6; references 25: 11 Russian, 14 Western

6508/8309
CSO: 18660087

UDC 521.1

PERIODIC ORBITS OF LIMITED ELLIPTICAL THREE BODY PROBLEM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 5 Mar 86) pp 321-323

[Article by V.P. Yevteyev]

[Abstract] A study is made of the problem of existence of periodic orbits in the immediate vicinity of the colinear libration points in the planar version of the elliptical three body problem. It is found that there are $2\pi/\lambda$-periodic solutions for libration points L_3. Conditions are outlined under which other periodic solutions appear, resulting in the theorem that in the immediate vicinity of libration point L_3, the equation describing the motion in the problem has periodic solutions with periods $T = 2\pi k$, where $k = 1,2,3,\ldots$, and the solutions are described in the form of a series which converges absolutely.

References 3: Russian

6508/8309
CSO: 18660087

UDC 551.510.535.4

'HOLES' IN OI 130 NM EMISSION FIELDS OF UPPER ATMOSPHERE DURING DAY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87 (manuscript received 29 Sep 86) pp 323-324

[Article by V.I. Krasovskiy and A.I. Semenov]

[Abstract] A review of photographs showing "holes" in the OI 130 nm emission fields of the terrestrial daytime upper atmosphere published by L.A. Frank, et al., reveals a multitude of "holes" of less contrast than those which the authors described and attributed to an influx of small comets into the Earth's upper atmosphere. All of the "holes" taken together form the nodes of a grid structure created by wave fronts mixing at an angle, well known from photographs of clouds and emission fields in the upper atmosphere. The waves may be ordinary sonic, internal gravitational and λ-waves, or shock waves from the polar auroras.

References 10: 1 Russian, 9 Western

6508/8309
CSO: 18660087

SPACE SCIENCES

UDC 612.014

QUASIPERIODIC VARIATIONS IN MANIFESTATIONS OF SOLAR ACTIVITY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 3 Jul 86) pp 325-328

[Article by M.V. Zil, V.G. Mitrikas, V.M. Petrov, V.P. Okhlovkov, L.S. Okhlopkova and T.N. Charazhyan (deceased)]

[Abstract] An attempt is made to analyze long-period variations in a number of geoheliophysical characteristics by a common method and to compare them. The following data sequences were selected: Wolf numbers, numbers of groups of Sun spots, frequencies of flares, results of stratospheric measurements, number of solar proton events with intensity at the maximum greater than a selected threshold, number of solar proton events with total proton flux over 10^5 protons per square centimeter, and results of measurement of the rate of formation of ^{37}Ar in a solar neutrino detector. A variation with a quasiperiod of two years is observed in various processes related to manifestations of solar activity. Spectral analysis of time series over the 20th and 21st solar activity cycles showed that their variations have three basic periods of less than 11 years: 2 years, about 1 year and about 5 months, the 2-year period being most pronounced. Stability of the quasiperiods varies for different phenomena. The period of the quasibiennial variation was less during the 21st cycle than during the 20th (1.66 and 1.89 years, respectively). Variations with periods of about 1 year and about 5 months become weaker with increasing power of the solar proton events analyzed.

Figures 3; references 17: 13 Russian, 4 Western

6508/8309
CSO: 18660087

UDC 581.521.6

SOLAR EVENT OF 27 APRIL 1981

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 30 Jun 86) pp 329-331

[Article by N.N. Volodichev, B.M. Kuzhevskiy and O.Yu. Nechayev]

[Abstract] The solar flare of 27 April 1981 had a duration of about 20 minutes and a total flux of gamma quanta in the 4-7 MeV band of about 100 protons per square centimeter. Continuous gamma radiation in the 0.29-1 MeV band, hard X-radiation and microwave radiation were also recorded, their time characteristics indicating that electrons and protons were accelerated to high energies practically simultaneously. A figure is presented illustrating the results of measurement of protons at 14-25 MeV by the IMP-8 satellite, $\gtrsim$100 and $\gtrsim$ 500 MeV by the "Prognoz-8" satellite and other types of electromagnetic radiation. The event of 27 April 1981 is compared with the event of 4 August 1972, of comparable length and intensity.

Figure 1; references 16: 6 Russian, 10 Western

6508/8309
CSO: 18660087

SPACE SCIENCES

UDC 521.2

APPLICATION OF CORRELATION METHOD OF RECEPTION OF DIRECT AND REFLECTED COSMIC RADIATION TO STUDY OF PLASMASPHERES OF PLANET AND DISTRIBUTION OF RADIATION BRIGHTNESS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 24 Jul 84) pp 332-334

[Article by D.Ya. Shtern and Ye.A. Garova]

[Abstract] An analysis is presented of reception of a mixture of direct and reflected low-frequency background cosmic radiation by an autocorrelation method. The analysis is applied to investigation of the plasmaspheres of the Moon and the planets, as well as the distribution of radiation brightness over the celestial sphere. Correlation processing of the direct and reflected low frequency background cosmic radiation signals received by spacecraft orbiting the Moon or planets can be used to determine the distribution of electron concentration in the plasma in the upper ionosphere and to study the distribution of the brightness of the low frequency background over the celestial sphere.

Figures 2; references 3: Russian

6508/8309
CSO: 18660087

IKI'S SPECIAL DESIGN BUREAU IN TARUSA DEVELOPS INSTRUMENT FOR 'PHOBOS' PROJECT

Moscow PRAVDA in Russian 12 Aug 87 p 2

[Text] Tarusa (Kaluga Oblast). An onboard instrument for scientific investigations in line with the "Fobos" program has been developed at the special design bureau of space-instrument building of the USSR Academy of Sciences' Institute of Space Research. Tests of a set of devices including this instrument have been conducted in Tarusa and Moscow. These tests demonstrated that the instrument meets all requirements made of it.

FTD/SNAP
/8309
CSO: 18660016

UDC 524.5

COMPARATIVE ANALYSIS OF ULTRAVIOLET OBSERVATIONS OF HALLEY'S COMET ON 'ASTRON' ASTROPHYSICAL STATION BEFORE AND AFTER PERIHELION

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 13 No 3, Mar 87 (manuscript received 8 Aug 86) pp 228-236

[Article by A.A. Boyarchuk, V.P. Grinin, A.M. Zvereva and A.I. Sheykhet, Crimean Astrophysical Observatory, USSR Academy of Sciences, Nauchnyy]

[Abstract] Spectrophotometric observations of Halley's comet were made in December 1985 using the UV telescope on the ASTRON station. Important conclusions could be drawn using more than 100 spectra of the comet at different distances from the nucleus and three photometric sections of the peripheral parts of the coma in the band OH (0-0) 3085 A. There is an asymmetry in the behavior of Q_{H_2O} in the orbital segments before and after perihelion, evidently attributable to structure of the cometary nucleus. There is a thermal inertia of the nucleus; its temperature and rate of sublimation of molecules from a unit surface prior to perihelion is lower than at the same heliocentric distances after perihelion. Other factors may also be responsible: a change in nucleus reflectivity after passage through perihelion and differences in its orientation relative to the sun before and after perihelion. Since during one transit the nucleus radius decreases by only about 1.5 m, some explanation must be found for the great photometric effect observed from transit to transit. The only possible explanation for the brightness reduction is a decrease in nucleus albedo as a result of degradation of its surface, with accumulation of large dust particles and the formation of a stable mineral crust. After 50-100 transits the comet should be transformed into an asteriodlike body with a low rate of gas sublimation and persist in such a state for an indefinitely long time. Figures 3; references 21: 4 Russian, 17 Western.

5303/8309
CSO: 18660103

UDC 542.510

MECHANISMS OF CLOUD LAYER FORMATION IN VENUSIAN ATMOSPHERE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 295 No 2, Jul 87 (manuscript received 23 May 86) pp 330-334

[Article by Yu.V. Zhulanov, L.M. Mukhin and D.F. Nenarokov, Physicochemical Scientific Research Institute imeni L.Ya. Karpov; Space Research Institute, USSR Academy of Sciences, Moscow]

[Abstract] Part of the "Vega" experiment was research on the aerosol component of the Venusian atmosphere using a photoelectric counter in the altitude range 63-67 km by the "Vega-1" and "Vega-2" descent modules. The experiment was carried out during 11 and 15 June 1985 on the nighttime side. Instruments were activated at 63 km and at 8-20 m intervals transmitted data on the number of registered particles with a diameter $\geqslant 0.5$ μm in the main chanel and $\geqslant 0.6$ μm in the second. This made it possible to compute averaged vertical profiles of concentration of particles $\geqslant 0.5$ μm in the altitude range 63-47 km. It was found that the cloud layer consists of two distinct cloud levels (upper--56-60 km, lower--49.5-46.5 km), separated by a zone of low particle concentrations. The cloud layer structure is extremely stable. The profiles of concentrations, especially at lower levels, are subject to strong fluctuations. The levels have clearly expressed boundaries caused by phase transitions of atmospheric components and are associated with definite temperature layers. These phase transitions at the boundaries are associated in turn with a temperature gradient decrease in the zone of cloud layer formation. With the freezing of primary cloud nuclei, consisting for the most part of aqueous sulfuric acid solutions, close to a monohydrate 85 percent, supersaturation occurs because the equilibrium vapor pressure over a solid surface is lower than over a fluid. This is only part of the mechanism of formation of the upper cloud level, since a significant role is played by radiative heating due to absorption of IR radiation from lower cloud layers. Formation of lower-lying clouds is by a different mechanism. In general, the nighttime cloud system can be represented as a thick formation of photochemical haze, with denser clouds being formed due to the enlargement of primary nuclei. Figures 3; references 9: 5 Russian, 4 Western.

5303/8309
CSO: 18660118

UDC 535.24:523.42

ATMOSPHERE OF VENUS IN SOUTHERN POLAR AREA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 25 Dec 86) pp 258-266

[Article by O.I. Yakovlev, V.N. Gubenko, S.S. Matyugov, G.D. Yakovleva and I.R. Vaganov]

[Abstract] Results are presented from studies of the Venusian atmosphere by radio transillumination from the "Venera-15 and 16" Venus orbiter spacecraft in the South polar area of Venus under both night and day conditions. The results are used to describe the status of the atmosphere in 11 regions of the planet in the 46-90 km altitude interval at -60 to -75.5° latitude with solar zenith angles of 65-118°. The variation of temperature, pressure and density with altitude and atmospheric parameters is presented in tabular form and compared with the results obtained by other methods. A cold "collar" is found in the Southern Hemisphere at latitudes of -60 to -70°, apparently not closed around the full latitude circle. No diurnal course of temperature variation was observed in the 50-90 km altitude interval, the mean daytime temperatures being almost exactly the same as the mean nighttime temperatures. Significant spacetime variations in temperature do occur, reflecting more complex atmospheric dynamics. The large-scale structure of the atmosphere near the South Pole is similar to the structure of the atmosphere near the North Pole, which also has a cold "collar" with significant temperature inversion, reaching 35 K in the 20-130 mbar pressure interval.

Figures 3; references 10: 5 Russian, 5 Western

6508/8309
CSO: 18660087

UDC 535.24:523.42

ATMOSPHERE OF VENUS IN SOUTH POLAR AREA BASED ON RADIO TRANSMISSION DATA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 20 Nov 86) pp 267-274

[Article by O.I. Yakovlev, V.N. Gubenko, S.S.Matgov and G.D. Yakovleva]

[Abstract] Continuing a previous article, presenting results on studies of the atmosphere of Venus in the North polar area obtained by transmission of radio waves through the atmosphere from the "Venera-15 and 16" spacecraft, results are presented from studies in six regions of the South polar area. Changes in the status of the atmosphere at altitudes of 50-90 km are analyzed for the latitude range of -82.5 to -89°, solar Zenith angles 82-91° covering the period of 30 October through 4 November 1983 and 29 August 1984. A comparison of the atmospheric parameters of the South polar area shows that the status of the atmosphere does not undergo significant variations over long intervals of time below the tropopause. The characteristics of the atmosphere at the tropopause, apparently related to atmospheric dynamics, do change significantly.

Figures 3; references 11: 6 Russian, 5 Western

6508/8309
CSO: 18660087

UDC 535.24:523.42

ATMOSPHERE OF VENUS IN NORTH POLAR AREA BASED ON RADIO TRANSMISSION DATA FROM 'VENERA-15' AND 'VENERA-16' SPACECRAFT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87 (manuscript received 4 Feb 86) pp 275-284

[Article by O.I. Yakovlev, S.S. Matgov, A.I. Yefimov, V.N. Gubenko, A.I. Kucheryavenkov, A.S. Vyshlov and G.D. Yakovleva]

[Abstract] The history of Soviet and American radio transmission studies of the Venusian atmosphere is briefly outlined. Results are presented from studies of the atmosphere in the North polar area, analyzing changes in the status of the atmosphere at 40-90 altitude, 81-89° latitude, 81-95° solar Zenith angles, 14-31 October 1983. Nine regions in the Northern Hemisphere of the planet are covered.

Figures 4; references 25: 15 Russian, 10 Western

6508/8309
CSO: 18660087

INTERPLANETARY SCIENCES

UDC 523.152.3

PECULIARITIES OF DAYTIME IONOSPHERE OF VENUS DURING YEARS OF LOW AND HIGH SOLAR ACTIVITY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87 (manuscript received 7 Jul 86) pp 285-291

[Article by A.L. Gavrik and L.N. Samoznayev]

[Abstract] Based on results of measurements from five satellites between 1975 and 1984, a study is made of the behavior of the major characteristics of the daytime Venusian ionosphere, including concentration at the main and lower ionization maxima, their altitudes, the altitude position of the upper boundary of the ionosphere, at various levels of solar activity. The ionospause of the Venusian atmosphere is found to be at higher altitude during periods of higher solar activity, the difference reaching 300-400 km. These differences in altitude cannot be explained by insufficient sensitivity of measurement methods, but rather represent a physically significant experimental result. The altitude of the ionopause is determined to a great extent by the dynamic pressure of the incident flux of the solar wind.

Figures; references 13: 5 Russian, 8 Western

6508/8309
CSO: 18660087

UDC 353.37:523.42

DISTRIBUTION OF ELECTRON CONCENTRATION IN NIGHTTIME ATMOSPHERE OF VENUS BASED ON RADIO TRANSMISSION DATA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87 (manuscript received 25 Aug 86) pp 292-300

[Article by I.K. Osmolovskiy and L.N. Samoznayev]

[Abstract] Some new results are presented, obtained from the "Venera-15 and 16" spacecraft, and all information available at the present on the altitude profiles of the electron concentration on the night side of the planet Venus are analyzed. The purpose of the comparative analysis was to determine slow variations in the characteristics of the nighttime Venusian ionosphere related to the phase of the 11-year solar activity cycle. The ionosphere is found to vary greatly with both location and time. The characteristics of altitude profiles of electron concentration change with the phase of the solar activity cycle. The mean value of electron concentration at the maximum of the main nighttime Venusian ionosphere layer is 30-70 percent greater during periods of maximum solar activity than during periods of low activity. An extensive plasma envelope extending to about 10^3 km is located above the main ionospheric layer during years of high solar activity. This plasma tail is not observed during the years of low activity. Numerical modeling indicates that radio occultation data, due to the limited sensitivity of the method, cannot be used at present to draw unambiguous conclusions concerning the presence or absence of an extended plasma area on the night side of Venus during periods of low solar activity, but rather merely indicate a maximum electron concentration.

Figures 4; references 14: 4 Russian, 10 Western

6508/8309
CSO: 18660087

UDC 621.371:523.4

APPLICABILITY OF EXTREMELY LOW FREQUENCY GLOBAL RESONANCES FOR STUDY OF VENUSIAN STORM ACTIVITY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87 (manuscript received 16 Jul 85) pp 301-306

[Article by A.P. Nikolayenko and L.M. Rabinovich]

[Abstract] It is suggested that the method of extremely low frequency studies of global thunderstorm activity, well tested on Earth, be applied to Venus. Resonant frequencies in the planet-ionosphere cavity of Venus are at 9,16,23 Hz, etc. Fields in this natural resonator excited by a point vertical electric discharge on the surface of the planet are analyzed. Experimental data obtained by direct measurement on Venus can be used to determine the coordinates of discrete lightning discharges, the propagation constant as a function of frequency and the parameters of an effective model of conductivity of the lower ionosphere.

Figures 4; references 15: 10 Russian, 5 Western

6508/8309
CSO: 18660087

MAGNETIC FIELD OF PLANET URANUS: PREDICTIONS, MEASUREMENTS, INTERPRETATIONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 16 Sep 86) pp 307-320

[Article by Sh.Sh. Dolginov]

[Abstract] Based on preliminary results of analysis of the measurements of the magnetic field of Uranus by the Voyager-2 spacecraft performed by Norman Ness, and the gravitational fields of the planet and its satellites performed by G.L. Tyler, et al., the magnitude and inclination of the eccentric dipole of Uranus are studied within the framework of a precession dynamo. The dipole and quadrupole components of the field of Uranus are computed on the assumption that they are generated upon precession of the planet, primarily under the influence of the gravitational field of the satellite Miranda.

References 43: 7 Russian, 36 Western

6508/8309
CSO: 18660087

INTERPLANETARY SCIENCES

UDC 523.4

DISCOVERY BY 'VOYAGER-2' OF PREDICTED SATELLITES WHICH DETERMINE RESONANCE NATURE OF URANIAN RINGS

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 13 No 3, Mar 87 (manuscript received 3 Jul 86) pp 237-244

[Article by N.N. Gorkavyy and A.M. Fridman, Astronomical Council, USSR Academy of Sciences, Moscow]

[Abstract] Until 1986 Uranus was known to have only five satellites and nine rings. Upon approach to Uranus the "Voyager-2" space probe in 1985-1986 discovered 10 new satellites and 2 new rings (one similar to the rings observed earlier, although fainter, whereas the other was broad and rarefied). Different hypotheses had been proposed concerning the nature and origin of the rings, including one by the authors (N.N. Gorkavyy, et al., ASTRONOM. TSIRKULYAR, No 1391, p 1, 1985; PISMA V ASTRON. ZHURN., Vol 11 No 9, p 117, 1985). This article compares their proposed hypothesis and the results of observations. A figure shows the hypothetical and discovered system of satellites; a table gives the orbital radii of the predicted and discovered satellites; the points in the hypothesis are compared item by item with observational data. Confirmation has been obtained for the postulated resonance nature of the Uranian rings. The resonance effect of an outer satellite favors the formation of a narrow ring. The formation of the narrow Uranian rings probably begins with the appearance of a series of spiral waves at the resonance points of the circumplanetary protodisk. The spiral waves could give rise to conditions for accumulation of accreting dust, resulting in increased ring density. The distance between the resonance point and the developing ring evidently cannot exceed the characteristic length of spiral wave propagation. The spiral waves disappear together with the protodisk after absorption of the latter by the rings or falling of disk matter onto the planet. Figures 2; references 20: 6 Russian, 14 Western.

5303/8309
CSO: 18660103

SPACE BIOLOGY AND MEDICINE

Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 87 pp 34-39

[Article by A. I. Grigoryev, Doctor of Medical Sciences; "Space Biology and Medicine"; the article is dedicated to the 20th anniversary of the Intercosmos program; the first paragraph appears in boldface in the source]

[Text] Medical and biological research has always assumed an important role in the space program. The number of experiments has grown with the emergence of manned missions. The work performed in the Intercosmos program represents a qualitatively new phase in the development of space medicine and biology.

The Fruit of Cooperation

Almost three decades separate mankind from the beginning of the space age, which was ushered in on October 4, 1957, with the Soviet launch of the first artificial earth satellite. Space flight was transformed from an unusual event into a regularly occurring affair, and the development of outer space assumed a systematic, practical course.

A dramatic example and model of international cooperation in space is, undoubtedly, the Intercosmos program, which got its start at a meeting in Moscow in April of 1967. Over the past 20 years, the countries participating in the program have assembled scientific and industrial collectives that are capable of solving the complex problems associated with the development of instruments and scientific gear and with the preparation and conduct of space research. A broad exchange of experience and knowledge and a permanent expansion of the volume and directions of cooperative ventures are bringing about a dynamic elevation of the scientific and technical level of cooperation among socialist countries in the development of outer space.

Occupying an important place in the Intercosmos program is joint scientific research in the field of space biology and medicine. The research is being conducted along three lines--"Space Physiology and Biology," "Space Psychology," and "Radiation

Safety in Space Flight." Plans for bilateral and multilateral agreements on specific research topics are being worked out in order to see the scientific programs through. A permanent working group is coordinating all the work. It meets once a year in one of the participating countries. Scientists are able to report the results of what they have done, exchange opinions on specific problems associated with the development of space biology and medicine, and discuss and formulate plans for subsequent joint ventures. In wide-ranging, exhaustive discussions at special symposia, scientists weigh the findings of research conducted aboard manned space flights, within the context of scientific programs on the biological earth satellites of the Cosmos series, and in ground-based experiments that simulate the effects of space flight on the human body.

The fundamental elements of the first stage of cooperation consisted of the business meetings of sciertists and specialists of socialists countries meeting at various international conferences and symposia, the exchange of research findings, the conduct of joint laboratory experiments, the preparation of plans, and the development of the equipment needed to perform the research under conditions of actual space flight.

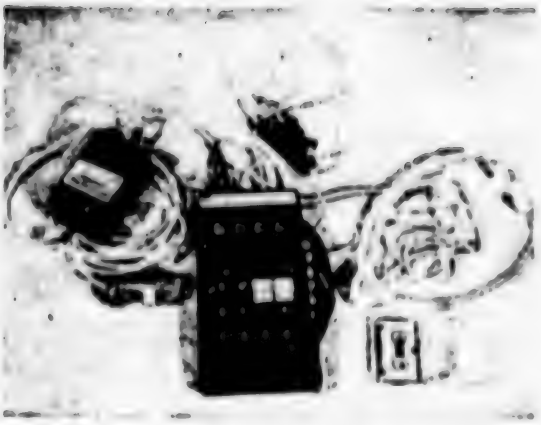
We can say with complete confidence that the flights that took place between 1978 and 1981, with international crews that included cosmonaut-researchers from socialist countries working aboard Soyuz spacecraft and the Salyut-6 orbiting scientific station, represent the peak of our cooperation in space. These flights included a broad program of medical and biological studies and experiments for which the participating countries devised and developed nearly 40 instruments and devices.

Many of the instruments--such as the Oksimeter (Czechoslovakia), for example, and the Elektrogustometr (Poland), the Balaton (Hungary), the Sredets (Bulgaria), the Elba (GDR), the Pille (Hungary), the Minidoza (SRR), and the Kontakt (Cuba)--were used successfully not only during the flight that carried a cosmonaut from a given country, but also on subsequent international expeditions and by Soviet cosmonauts on lengthy flights.

Thus, the continuity of the orbital research was the most significant feature of this stage. The flight of each international crew greatly expanded and enriched the research conducted by the previous crews. And the findings of each flight became the property of all the program's participants.

In Orbit--Biosatellites

Experiments conducted aboard the Soviet biological earth satellites of the Cosmos series contributed considerably to the



Instruments used during space flights within the Intercosmos program; the Oksimetr (left), designed to study oxygen supply to human tissue; the Balaton (upper right), which helped study human performance; and the Sredets (lower right), with which psychophysiological studies were performed

success of the space flights' medical and biological programs. Beginning in 1973, seven biosatellites were launched. Intercosmos specialists prepared their own biological research subjects [bioobyekty] and onboard scientific gear and took part in the development of scientific research programs as well as in pre- and post-flight studies of the biological subjects and in the analysis of the data. In the end, all this increased the number of studies that were conducted and made them more meaningful in scientific terms.

The joint research aboard the manned flights, the experiments aboard the biosatellites, and the simulations produced a wealth of essentially new data that is exceptionally important not only for solving fundamental problems associated with space biology and medicine, but also for improving the medical support system

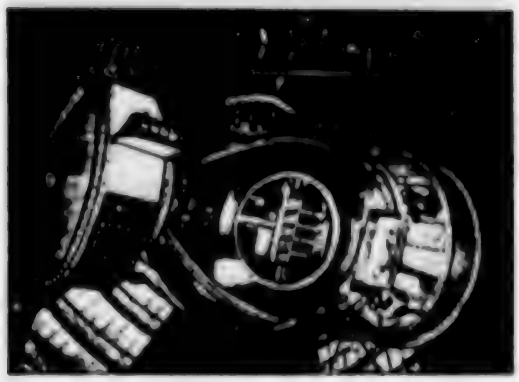
available aboard space flights. It may be good at this point to look at some of the findings of the research.

An experimental program called "Optokinez" [optokinesis] was formulated to pinpoint the mechanisms of development of motion sickness in space. The experiment centers on a combined methodology (from Bulgaria, Hungary, and the USSR) involving optokinetic stimulation. The successful performance of this experiment during manned flight aboard the Salyut-7 made possible the first-ever quantitative evaluation of the dynamics of the changes in vestibular and oculomotor functions at various stages of the flight. The data obtained can serve as a basis for developing methods to evaluate job-related changes in sensory system activity, as well as create preventive measures for increasing the reliability of operator performance during flight.

Metabolic changes--in particular, the water-salt metabolism--were studied in detail. Data from the "Stress-indikatsiya" [stress indication], "Metabolizm" [metabolism], and "Stress" experiments (Hungary, GDR, Cuba, USSR), which were performed on the flights with international crews, provided a great deal more information on the processes associated with man's biochemical adaptation to the short-term effects of a gravity change. A study of hormonal regulation under conditions of space flight (Hungary, GDR, Poland, USSR, Czechoslovakia) was fruitful. The "Obmen" [exchange] experiment, in which the Plazma instrument (Czechoslovakia) was used, produced data on changes in the metabolism of steroid hormones.

Detailed studies of animals that had flown aboard biosatellites enabled researchers to identify the mechanisms associated with changes in the water-salt metabolism produced by weightlessness and to understand more about the patterns of nonspecific adaptation of the body to the effects of space flight. It is believed that the slow-down, detected in the animal experiment, in the growth of skeletal bones and in the processes of their mineralization is due to, among other things, an overall change in the animal's calcium balance during flight.

Motor system studies (Hungary, Bulgaria, Cuba, USSR) indicated that the sensitivity of various sensory mechanisms in man can change under conditions of weightlessness. This may be the cause of the motion impairment and functional atrophy of muscles that are observed after space flights. The findings of the experiments involving animals flying aboard the biosatellites paved the way for improved use of dynamic and static loads on manned flights. In addition, they made it possible to substantiate several recommendations in the choice of diagnostic



Biological satellite of the Cosmos series

methods for evaluating the condition of the human locomotor system during flight and in the readaptation period.

Using a complex method developed (by Hungary, GDR, Bulgaria, Poland, USSR, and Czechoslovakia) to determine oxygen saturation [napryazheniye kisloroda] in the organs and in tissue and, simultaneously, in arterial blood (oxygen topography), researchers conducted a study of the oxygen content of the human body. This expands the possibilities for functional diagnosis under conditions of weightlessness considerably.

The scientific investigations conducted within the Intercosmos program have resulted in the development of onboard techniques and gear that are used to identify various aspects of the psychophysiological condition by means of subjective evaluation and time and psychomotor indices. The data obtained in the joint research form the basis of recommendations that have been made to improve work and rest conditions and the means for providing leisure during space flight.

The set of techniques and equipment developed in the Intercosmos program, along with those that already existed, enables researchers to thoroughly study radiation conditions and to check the various standards pertaining to possible radiation danger in space.

Studies attempting to find and substantiate means of preventing weightlessness from having adverse effects on the human body are of considerable value to the continued development of manned cosmonautics. A biosatellite study of the biological effects of an artificial gravity created by spinning an animal in an onboard centrifuge showed that the use of that gravity prevented, to a degree, certain negative aftereffects of

weightlessness. It would seem that artificial gravity, along with other techniques, may be viewed as one of the possible means of keeping man in good condition on lengthy space flights.

Biological Experiments

As manned space flights become lengthier, the problem of creating aboard the spacecraft biological life-support systems that include various plant and animal organisms becomes all the more urgent. In searching for a solution to this problem, Intercosmos experiments on the biosatellites and on the manned flights studied the mechanisms associated with the adaptation of various biological systems to weightlessness and, in particular, the effect of weightlessness on growth and development.

Experimental models of closed ecological systems that, theoretically, could be used as biological life-support systems in space flight have been created and are being studied at the present time. The work that has been done has made it possible to formulate the basic requirements for the equipment that is needed for the next stage of research. Czechoslovakia is developing a single-cell algae unit, and Hungary is devising a new type of space greenhouse, the Svet, for higher plants.

The embryological experiments conducted on the biosatellites are of great importance. An experiment on the Cosmos -1514 biosatellite, for example, resolved for the first time ever the basic question of the possibility of fetal development in a mammal under conditions of weightlessness. The joint efforts of specialists from various countries (Hungary, GDR, Poland, SRR, USSR, Czechoslovakia) produced a large volume of unique information on the condition of internal organs and the development of analyzer systems and behavioral responses in mammals who have spent part of the prenatal development period in space.

It is important to emphasize that the Intercosmos studies of living organisms aboard spacecraft not only are of great practical value in terms of the medical and biological support they provide for manned space flight. They also make a substantial contribution to the enrichment of the theory associated with the general patterns that organisms follow in adapting to the environment as well as a considerable contribution to the development of concepts on the role gravity has played in the origin and evolution of life on Earth.

The Vistas of Cooperation

The 20 years of experience garnered by the successful joint research in the Intercosmos program testifies to the high degree of effectiveness of such collaboration in the study and development of outer space. The main idea of Intercosmos is to

use the strongest points of each partner for the general good. The continued development of cooperation in the field of cosmonautics and, in particular, in solving the increasingly complex problems of space biology and medicine require continual improvement of the forms and techniques of joint research.

New joint efforts are slated for the near future. Studies of the processes involved in man's adaptation to weightlessness and investigations of effective methods and means of maintaining high efficiency in an individual during all stages of flight will continue. A major role will be assigned to the study of the mechanisms of development of vestibular and vegetative disorders and metabolic changes under conditions of weightlessness and to the formulation of ways of diminishing them. The development and comparative analysis of various methods of simulating the physiological effects of weightlessness is of great significance for clarifying the specific causes of the action of weightlessness.

Scientific investigations that involve the creation of biological life-support systems aboard spacecraft play a significant role in the long-range plans for collaboration. Consequently, research will be continued on various plants and animals to identify mechanisms for adapting biological systems to weightless conditions.

As the duration of space flights increases, a great deal of importance falls to psychological studies aimed at maintaining an individual's efficiency when he must spend lengthy periods under weightless conditions, especially outside the spacecraft. The ways and means of providing radiation protection during space flight will be improved.

The plans of this cooperative effort have great regard for the notion of putting the techniques and equipment created in the Intercosmos program to use in the health-care field. The enormous possibilities of employing aspects of cosmonautics, especially space medicine, in "Earth medicine" are already apparent today. And the first steps have been taken in that direction within the framework of the collaboration. The Oksimetr instrument, for example, which was developed for studying variations in oxygen supply to human tissue during space flight, is being used in several clinics for diagnosing a number of disorders: in stomatological practice, it is used for periodontoses; in surgical practice, for plastic surgery involving skin transplants (it is used for determining the readiness of a given sector of skin for transplantation); in internal medicine, for peptic ulcers of the stomach and the duodenum; in cardiology, for ischemic heart disease, for the

purpose of identifying a predisposition of the vascular system to spasms.

The Balaton instrument, developed to analyze operator performance and mental efficiency, is used in various professions that involve a great deal of emotional tension and require a great deal of mental effort.

The numerous space-medicine studies have provided a large body of scientific material that thoroughly describes the response of the human body to lengthy restriction of movement. We now know that hypokinesia causes universal reactions from practically all physiological systems of the body and leads to changes in the regulatory systems. The information obtained on the mechanisms of the functional shifts caused by hypokinesia is taken into account in the treatment of patients confined to bed for lengthy periods and in the assignment of bed rest, in terms of its strictness and duration. Means and methods developed by space medicine for preventing de-conditioning [detrenirovannost] of various of the body's systems helps in hypokinesia to fight against the effects of a phenomenon that is extremely widespread in our time--lack of physical activity.

Space medicine has garnered a great deal of experience in the active control of the adaptation processes of the body and in the stabilization of an individual's health, something that undoubtedly has applications in the theory and practice of general medicine and various lines of applied physiology.

Practical health care can draw much from the findings of research conducted in the field of space psychology. The concept of psychological compatibility, which reveals the nature and features of interpersonal relationships in group activities, especially in isolated settings, is scientifically substantiated and has been put into practice. There exists at the present time a body of experience for assembling collectives for various purposes. The selection of the members of a collective is based on the principle of psychological compatibility developed by space psychology and whose consideration increases the effectiveness of group performance and improves the psychological climate in the group. This pertains, in particular, to groups aboard spacecraft, in underwater laboratories, at polar stations, or on sports teams and in many production settings (in medicine, for example, such groups would consist of emergency medical service personnel).

However, in spite of the definite contribution space medicine has made to health-care practice, it is still indebted to the medicine practiced here on Earth--which is to say that it has

drawn more experience than it has given. And in that regard, there is still much to be done, including work within the framework of the Intercosmos program.

We have high hopes for the prospect of using the achievements in space to assist economic and social progress and to solve many of the problems facing mankind, including those like the prevention or elimination of disease. Advancement to these goals lies on the road to the peaceful development of an outer space that is not militarized. Only then can the various states realize challenging scientific programs whose findings will serve the well-being of all the peoples who populate our planet.

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RESULTS OF RESEARCH WITH BIOLOGICAL SATELLITES

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 18 Sep 87 p 4

[Article by G. Lomanov, correspondent]

[Abstract] The article records comments of scientists on the research program for the upcoming flight of a "Cosmos" biological satellite.

Doctor of Biological Sciences Yevgeniy Aleksandrovich Ilyin, head of a sector of the USSR Ministry of Health's Institute of Medical-Biological Problems, showed the author of the article one of the macaque monkeys that were being readied for the space experiments. The animals were obtained from the USSR Academy of Medical Sciences' Institute of Experimental Pathology and Therapy in Sukhumi. Ilyin mentioned some of the more important results of research which has been conducted with biological satellites over the last 15 years. In particular, weightlessness has been found to produce no destructive effects on tissues, intracellular processes and the principal systems of an organism. This means that space missions lasting as long as a year can now be authorized. With the aid of biological satellites, radiation-safety norms have been substantiated, radiation monitors for manned spacecraft have been tested, and studies of the locomotor system have been conducted. These studies have led to development of a system of measures and physical exercises for preventing atrophy of groups of muscles that are not exerted in zero gravity, as well as loss of calcium from bone tissue.

Doctor of Technical Sciences Boris Andreyevich Adamovich, deputy director of the Medical-Biological Institute, observed that developers of life-support and monitoring systems for biological satellites have special problems to solve. Medical monitoring of experimental animals, for example, is said to involve recording of about 30 physiological indicators of vital processes in the course of a flight. Adamovich mentioned that the program for the upcoming space experiments calls for postflight studies of subjects to begin immediately after the satellite lands. Almost 50 people will take part in this work, which will be done inside inflatable shelters. Helicopters will deliver the shelters to the point of landing.

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PREPARATIONS FOR FLIGHT OF 'COSMOS-1887' BIOLOGICAL SATELLITE

Moscow SOVETSKAYA ROSSIYA in Russian 4 Sep 87 p 6

[Article by V. Pishchik]

[Abstract] The article reports on work which specialists of the USSR Ministry of Health's Institute of Medical-Biological Problems are doing in preparation for the next launch of a "Cosmos" satellite carrying biological specimens. They will include rats, amphibians, fish, insects, plants, and two monkeys. The monkeys were to be selected from a group of 50 which began to be readied for the flight about a year ago. The selection would be made on the basis of the monkeys' ability to perform operations prescribed by the experiment, such as pressing certain levers in response to signals appearing on screens. The final stage of preparations for the space experiments reportedly included ground tests of recording apparatus and life-support systems similar to those with which the biological satellite will be equipped. In the course of these tests, subjects spent a period of 14 days inside a mock-up of the satellite.

The upcoming mission is said to be the eighth in a series which began in 1973. With regard to the methods and objectives of research with specialized biological satellites, academician Oleg Georgiyevich Gazenko, director of the Medical-Biological Institute, explained that mechanisms of changes which take place in organisms in space conditions are being studied for the purpose of improving medical support of manned space missions. About 50 research institutions of socialist countries, the United States and France are taking part in this program. Representatives of the European Space Agency will also take part in it during the upcoming "Cosmos" flight, which is scheduled to begin at the end of September.

Various types of sensing devices will be attached to the monkeys on board the satellite, Gazenko related. Effects of weightlessness on the tissue and cellular levels will be determined and changes in the functioning of the vestibular apparatus and the redistribution of blood in an organism will be evaluated with the aid of these devices. The space studies of rats are expected to increase substantially scientists' understanding of biochemical changes which take place in bone and muscular tissues from the effect of weightlessness, and to provide more detailed information on the hormonal and immune status of subjects in such conditions. Gazenko mentioned that problems of radiation safety

also are being studied with biological satellites in connection with work on improving methods for monitoring radiation conditions in space and on baord spaceships, and on development of promising radiation-protection systems.

A photograph is given showing a monkey seated in a chair of the type designed for biological satellites.

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RESEARCH ON COTTON PLANTS GROWN IN SPACE

Tashkent PRAVDA VOSTOKA in Russian 22 Jul 87 p 3

[Text] An experiment which Vladimir Aleksandrovich Dzhanibekov and Viktor Savinyukh began on board the spaceship "Soyuz T-13" in June 1985 is continuing in Tashkent.

Two years ago, 20 cotton-plant seedlings that had been planted in space were delivered to the [Uzbek] Academy of Sciences' Institute of Experimental Biology of Plants. Bolls of the 'space' harvest's second generation have now appeared.

Pilot-cosmonaut of the USSR Dzhanibekov proposed that experiments with the cotton plant be included in a program of space biology research. A container was loaded into a spaceship which was departing on a four-month mission. Inside this container were seeds of genetically pure fine-fibered and medium-fibered varieties of the cotton plant from the institute's collection.

The first two experiments for growing seeds in orbit proved unsuccessful. The next time, the cosmonauts prepared more carefully for the experiment; they literally breathed on the seedlings; and they devised a special procedure for watering them. The first green leaves appeared while the mission was in progress. Cotton thus became the third agricultural crop, after wheat and peas, to sprout on board a Soviet spaceship. Transporting the plants to the biology institute following their return to Earth was just as complicated.

Associates of the institute's laboratory of cytoembryology and cellular engineering are continuing the experiment under the direction of Candidate of Biological Sciences Abdi-Kadyr Ergashev. They are to establish how zero gravity and other conditions of space flight affected the cellular level and hereditary apparatus of the cotton plants. Interesting changes in fiber lengths are now being observed in one of the plants.

Vladimir Dzhanibekov was recently shown work which the biologists are doing. It has been agreed that experiments with cotton plants in orbit will be continued.

(A photograph is given showing Ergashev talking with Dzhanibekov.)

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GYROSTABILIZER SYSTEM OF 'KVANT' MODULE

Moscow PRAVDA in Russian 6 Sep 87 p 3

[Article by N. Sheremetyevskiy, academician and B. Chertok, corresponding member of the USSR Academy of Sciences]

[Abstract] The authors comment on the development and features of the system used to control the rotary motion of the space complex "Mir" and orient it precisely during astronomical observations with equipment of the "Kvant" module. This system allows the complex to be stabilized with a precision of one minute of arc, it is claimed. The system is said to include high-precision angular velocity meters, inertial sensors of angular position, an onboard computer complex with a modular structure, and powered gyroscopes (gyrodynes on a magnetic suspension) which function as drive motors. Particular attention is devoted to these motors, which are said to permit substantial savings of fuel as compared with the control systems of "Salyut" space stations. The "Mir" station's electromechanical drive motors are powered solely by solar batteries and storage cells, it is noted.

Development of gyrodynes for the "Kvant" module involved mathematical modeling of electromagnetic, dynamic and thermal processes, the authors relate. Mathematical modeling also indicated the necessity of a special system of spatial arrangement for six gyrodynes on the module and was used to prepare highly complex algorithms for the control system's computer. These algorithms take into account maintenance of the system's controllability in any type of orientation of the "Mir" complex, and also while the gyrodynes are being put into their initial state, using only a gravitational system which conserves power sources. The computer and its software also allow corrections in the program to be made at any stage of the system's operation (including flight).

The authors compare this system with an orientation system that was installed experimentally on the stations "Salyut-3" and "Salyut-5," and with the orientation and stabilization system of "Meteor" spacecraft. They note that the "Salyut" system employed a spherical motor of the flywheel type on a magnetic suspension, while the "Meteor" system has three electromechanical flywheels. The "Mir" complex's powered gyroscopes are said to be substantially more efficient than the flywheel motors from the energy standpoint, taking the complex's substantially larger moments of inertia into account.

Results of work on the space orientation and stabilization system are expected to find use on Earth in development of powered electromagnetic bearings for rotating parts of machines. In ground tests, prototypes of powered gyroscopes that were developed for the space complex operated reliably for about 10,000 hours, it is claimed. The authors mention in conclusion that development of turbine generators, including mobile ones, with magnetic bearings has begun in line with a large-scale program.

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FACILITIES OF PLESETSK LAUNCH COMPLEX DESCRIBED

Moscow KRASNAYA ZVEZDA in Russian 29 Aug 87 p 4

[Article by Yu. Zaytsev, engineer, veteran of the [Plesetsk] Cosmodrome]

[Abstract] The article gives an account of the construction of the space-launch complex at Plesetsk in Arkhangelsk Oblast. Information is provided on present-day equipment, activities and personnel of this facility. Launchings of spacecraft for research and economic purposes take place here, as well as launchings in line with international space programs. Specialists of Sweden, Canada, the United States, India and France reportedly have taken part in these programs.

The author explains why the decision was made to build the Plesetsk Cosmodrome in a sparsely-populated area of the northern USSR. Many problems of space research require placing of satellites into polar and near-polar orbits, and this can be done advantageously from sites in high latitudes, he points out. Such orbits are preferable for meteorological satellites which travel at low altitudes, for example. Although the Plesetsk facility is located at a safe distance from population centers, it is an area from which reliable communications can be maintained with research and production centers.

At the present time, the Plesetsk Cosmodrome is said to include complexes of rocket service and launching areas, facilities where units of rocket-and-space systems are assembled and tested, a coordination-computer center, tracking stations, a measurement complex, and geodetic and meteorological services. Among the complexes are sites for launching "Meteor" and "Molniya" satellites. These sites are said to be similar in plan to the one used for "Soyuz" launch rockets. Small and medium-sized satellites of the "Cosmos," "Intercosmos" and other series are launched from complexes called "Raduga" and "Voskhod," which are differently designed. Rockets launched from them are prepared with the aid of a unified set of equipment and a mobile tower, the author relates. The rockets are placed directly on supports of the launching platform instead of being suspended. Each rocket and its launching equipment are enclosed inside the tower while launch preparations are in progress, which enables maintenance personnel to work normally in any kind of weather and at any time of the day. The tower is 100 meters tall and travels on rails. Its base is about 200 square meters in area, and it has an overall mass of 450 tons. If necessary, one spacecraft can be replaced with another while a rocket is inside the launching device.

The author goes on to praise the caliber of the cosmodrome's research-and-testing service, which prepares rocket and space systems for launching. B.N. Morozov is the head of this service. Among the heads of its divisions are V.N. Artemenko, V.S. Rybin, V.A. Grin, Sh.G. Kaziyev, N.S. Belyshev, A.N. Osadchenko and A.F. Ovchinnikov.

A photograph is given showing a spacecraft inside the cosmodrome's installation-and-testing building. The spacecraft bears the inscription "Interkosmos Bolgariya-1300."

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SINGLE-BURN TRANSFER TO NOMINALLY PERIODIC ORBIT IN THE VICINITY OF POINT L_2 OF EARTH-SUN SYSTEM AND RELATED PROBLEMS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87 (manuscript received 15 Sep 86) pp 163-185

[Article by M.L. Lidov, V.A. Lyakhova and N.M. Teslenko]

[Abstract] A study is made of computational problems related to insertion into orbit and maintenance of the movement of a spacecraft in the vicinity of the colinear libration point L_2 of the Earth-Sun system. Some space experiments require maintenance of a spacecraft for a long time in the vicinity of the libration points L_1, L_2 of the Earth-Sun system. In this article, the authors limit themselves to analysis of points L_2, since the analysis for the vicinity of point L_1 is quite similar. A single-burn transfer from an intermediate Earth satellite orbit to a nominally periodic orbit closest to L_2 is computed. Movement of the spacecraft in the nominally periodic orbit for a long period of time is calculated. Numerical estimates are obtained of the characteristics of the single-parameter transfer trajectory correction compensating for insertion error. The regular algorithm developed for numerical solution of the problem of the single-burn transfer from intermediate Earth satellite orbit to asymptotic manifold in the vicinity of L_2 first determines the approximate values of initial movement parameters near the Earth to achieve the trajectory. The data obtained is then refined by numerical integration of a system of equations sufficiently accurate for methodologic purposes.

Figures 6; references 6: Russian

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STUDY OF DESCENT OF PROBES WITH HIGH LIFT-DRAG RATIO INTO THE ATMOSPHERE OF JUPITER

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 21 Jun 85) pp 193-203

[Article by G.M. Lokhov and M.K. Rozhdestvenskiy]

[Abstract] Descent of probes with high lift-drag ratios is technically complex. This article analyzes the thermal loading on a Jupiter probe to determine flight modes assuring minimum weight of heat protective asbotextolite or graphite heat protective coating. Nominal trajectories are determined by thermal analysis under the boundary conditions accepted. Active control of the probe allows expansion of the entry corridor, decreasing maximum acceleration and increasing the fraction of total mass represented by payload. A method is suggested for creating variable lift to guarantee control of a probe in the atmosphere of Jupiter. Application of methods of invariant control to maximization of the final relative probe mass at an assigned altitude in an incompletely known atmosphere is studied. Some results are presented of calculation of the descent of gliding probes into the atmosphere of Jupiter. The materials show the possibility in principle of braking glider probes in the atmosphere of Jupiter by repeated passage through the atmosphere in an orbital descent mode.

Figures 5; references 9: 8 Russian, 1 Western

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SPACE ENGINEERING

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SELECTION OF EFFICIENT CORRECTING MOTOR FOR AN ARTIFICIAL EARTH SATELLITE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 25 No 2, Mar-Apr 87
(manuscript received 12 Dec 83) pp 204-215

[Article by M.A. Kuzmin and Yu.N. Chilin]

[Abstract] Mathematical modeling is used to study the influence of the functioning conditions of an Earth satellite and a number of parameters of its power system on the selection of an efficient type of correcting motor installation. The major quality characteristic of the operation of the power system, which is intended to provide electric power to spacecraft systems and achieve orbital correction, is the launch mass of the power system, determined by the total mass of solar batteries including solar panel opening and orienting systems, and the mass of the systems which stores the working fluid. A method is presented for determining areas of application of chemical and electrical reaction motors. Dimensionless parameters are presented to determine the expediency of using constant-thrust electric reaction motors.

Figures 5; references 4: Russian

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SATELLITE MONITORING OF EARTHQUAKE PRECURSOR EFFECTS IN MAGNETOSPHERE

Moscow ZEMLYA I VSELENNAYA in Russian No 3, May-Jun 87 pp 45-50

[Article by Yu. I. Zaytsev, under the rubric "Space": "The Echo of Earthquakes in Space"; first paragraph is source introduction, section headings and boldface text given in all caps]

[Text] During satellite overflights of seismically active regions of the earth, special equipment is recording bursts of electromagnetic radiation in the earth's ionosphere and magnetosphere. These bursts frequently not only accompany a seismic shock, but also precede it.

Earthquakes have always been occurring on earth. They are described even in the ancient folklore and epic works of the various peoples of the world which have come down to us, as well as in the medieval chronicles and in modern literature. The earthquakes inflict particular great damage in seismically dangerous regions. And this is why the problem of predicting seismic shocks remains so urgent (see, for example ZEMLYA I VSELENNAYA, 1987, No 1, p 4--editor's note).

This problem is a difficult one and, one can say, an ideal prediction has been given up till now only once--for the earthquake on 4 February, 1975, in northeastern China. At 10:30 am on this day, an official statement was issued about an impending strong earthquake. By 2 pm, an order was issued regarding the evacuation of the entire population and the carrying out of a series of emergency measures, and at 7:36 pm, the earthquake struck. Up to 90 percent of the **buildings** were destroyed or seriously damaged. Yet the number of casualties amounted to 200-300 people out of a population in the earthquake region of approximately a million....

AN EARTHQUAKE AFFECTS THE IONOSPHERE

For many years, knowledge about various natural phenomena, which could be the precursors of earthquakes, was based on observations exclusively on the earth's surface. In recent times, widespread use has been made of physical and mathematical simulation. But the question arises: Is it not possible to use space-based methods to predict seismic danger? In the opinion of a number

of researchers. It is possible that precisely from here there is a direct path, if not to the prediction of earthquakes (where? when? what strength?), then at least to predictive estimates.

At the present time, there is almost no doubt about the effect of solar activity on the processes not only in near-earth space, but also on geophysical and meteorological phenomena on earth. Movements of the earth's environment, the actual radiation of the atmosphere, the ocean and the earth's surface--all these things are reactions to that stream of energy which arrives from the sun and to fluctuations of this stream. The connection between solar and terrestrial phenomena is accomplished by means of electromagnetic and particle radiation due to plasma processes.

Right at the very beginning of the space era, the solar wind was discovered--the streams of plasma particles in interplanetary space. The wind is generated by the solar corona--the silvery pearl-like plasma sphere extending for tens of millions of kilometers beyond the edge of the solar disk.

The earth is an enormous magnet and therefore the solar wind actively affects the formation of its magnetosphere. On the sunward side, it turns out to be "compressed" towards the earth, while on the "leeward" side, it is streached out for tens of millions of kilometers, forming a long magnetic tail. As a result of the interaction of the magnetosphere with the ionosphere, powerful electrical currents arise, which form a unified electrical system encompassing all of near-earth space. With the aid of this current system, the solar wind's kinetic energy can be transferred to the thermal energy of the upper atmosphere and the energy of the particles of the near-earth plasma. As a result, various geomagnetic disturbances arise, which, apparently, are capable somehow of stimulating the formation of cyclones and anti-cyclones at the earth's polar caps and affect biological systems. In particular, they can worsen the state of health of people suffering from cariovascular diseases.

However, even our planet itself, it turns out, actively affects its own electrical shell. For example, on Kamchatka a volcanic explosion occurred and in a region thousands of kilometers distant from it, radio communications ceased. It turns out that something similar also occurs during earthquakes, large-scale waves and inhomogeneities arise in the ionosphere, which can be clearly traced by their effect on shortwave radio paths.

This phenomenon was discovered by Soviet scientists nearly 20 years ago. But for a long time it remained unclear, how the earthquakes' effects were transmitted to the ionosphere--either by means of acoustic waves or some kind of electrical phenomena? The majority of researchers favored acoustic waves, inasmuch as, at that time, it was already well known that strong volcanic explosions led to the generation of subsonic vibrations which then propagated over great distances.

But what is an acoustic wave? It is a compression and thinning of air which move at great speed one behind the other. The propagation of such a wave in the upper atmosphere changes the profile of the electron concentration in the ionosphere and various types of inhomogeneities arise. In other words, under the action of an acoustic wave along the front of the ionosphere, vibrations occur which are remniscent of ripples on a water surface. As a consequence of this, disruptions grow in the propagation of radio waves reflected from the disturbed area. All this is so. Yet, nevertheless, it would be incorrect to discount the possibility of the emergence of some kind of additional significant electromagnetic phenomena caused by earthquakes.

The well-known Soviet geophysicist, M. B. Gokhberg, and his associates from the USSR Academy of Sciences' Earth Physics Institute, over the course of many years, have conducted a search for such electromagnetic phenomena, carefully analyzing the observational data available both in the Soviet Union and abroad. And they managed to find something. For reliable statistics, it is true, this was a very small thing, but what was important was the very fact of the existence of such phenomena.

Somewhat later, associates of the USSR Academy of Sciences' Terrestrial Magnetism, Ionosphere and Radio Wave Propagation Institute, together with associates of the USSR Academy of Sciences' Earth Physics Institute, discovered that after strong earthquakes, which occurred in the vicinity of the equator, the INTERCOSMOS-19 satellite recorded in the vicinity of their epicenters unusual ELECTROMAGNETIC NOISES. Even though the statistics were also small, all the same, as they say, one thing led to another.

Then the question also arose: is it not possible to attempt to simulate the effects of an earthquake, i.e., artificially reproduce its effect not only on the middle and upper atmosphere and ionosphere, but also on near-earth space? A man-made explosion, a mountain landslide, the collapse of a roof in exhausted mines, and even the movement of a heavily loaded transport--all of these things lead not only to the vibration of soil, but also to the emergence of waves in the atmosphere. And these waves differ only in the cause of their generated vibrations, and correspondingly, the strength of the vibrations, their expansion in space and the capability of reaching the heights of the ionosphere and the magnetosphere. Thus, there arose a program of active scientific experiments for simulation of the magnetospheric and ionospheric links during seismic phenomena using the method of powerful chemical explosions (its abbreviated name is MASSA [Mass]).

HOW TO CONDUCT THE EXPERIMENT?

The effects of such links can be investigated in minutest detail only under conditions of the conducting of strictly controlled experiments. Their success, therefore, depends to a large extent on the carefulness of the preparations. At first, difficulties of an organizational nature arise. A large quantity of explosives--on the order of several hundred tons--needs to be placed in a region remote from populated areas. Then it needs to be placed on an absolutely level site, so that it would be possible to clearly separate

Soviet and French specialists conduct complex electrical tests of the OREOL-3 satellite.

the magnitude of the explosion energy that goes downward from that which is directed upwards into the atmosphere. It is necessary to prepare a large number of measuring stations and to equip them with receiving and recording equipment for observation of the explosion's effect in the atmosphere, i.e., the movement of the shock wave, the reflected signals and the propagation of waves in the ground, and so on. Before conducting the experiment, it is necessary to carry out regular launches of meteorological radiosondes at points located at various distances from the explosion site. And finally, it is necessary to coordinate very accurately the activities on the ground and in space: the explosion should take place precisely at that moment when a

satellite equipped with the necessary measuring equipment is overflying the region of the experiment. As is well known, its speed while travelling along its orbit is great--nearly 8 km s--and therefore, an error of even tenths of a second can result in the spacecraft not recording the seismic wave.

It was decided that research on the processes in space be conducted from on board the OREOL-3 satellite. It was launched in accordance with the Franco-Soviet cooperation program (project ARKAD-3) and had on board sufficiently sensitive instruments for diagnosis of the plasma and the variations in the magnetic and electrical fields. It would be impossible to have a more suitable complement of scientific equipment for the recording of the explosion's effects and their influence on the ionosphere and magnetosphere.

The OREOL-3 Satellite.

Based on calculations, it has been assumed that at first the acoustic wave will rise upwards and after 5 to 7 minutes will reach the ionosphere. Here the movement of neutral particles, caused by the acoustic wave, during collisions with ions, will cause their displacement relative to magnetized electrons. A dynamo effect arise which should lead to the local generation of an electrical field and currents. In other words, the movement of the neutral gas of the ionosphere under the influence of the acoustic wave will play the role of an antenna which will modulate the electric currents. At the same time, in the vicinity of the explosion's tube of force (tube of magnetic force, resting on a site at an altitude 100 km directly above the explosion point), because of the asymmetry of the phenomena in the northern hemisphere, where the acoustic wave is propagating, and in the magnetically linked ionosphere of the southern hemisphere, longitudinal current should arise and plama noises should be generated. We are talking about Alfven waves, i.e., specific electromagnetic oscillations, which propagate well along the force lines of the magnetic field. In an Alfven wave, not only the electromagnetic field participates in the vibrations, but also particles of the conducting medium itself, in this instance--the magnetospheric plasma.

Real-time calculations of satellite orbit parameters made it possible to determine beforehand its intersection moment with the explosion's tube of magnetic force with an accuracy of up to several seconds and to select

correspondingly the time of the explosion. The satellite intersected this tube of force approximately 6 minutes after the explosion and discovered in it the characteristic "spot" of increased intensity of the electromagnetic noises in the broad spectrum of frequencies. Moreover, at a distance of nearly 700 km to the south of the tube of force, the satellite's on-board magnetometer discovered a strong, yet also brief blow-out of the magnetic field, which was accompanied by a burst of ELECTROMAGNETIC OSCILLATIONS--from tens to several hundreds of hertz, and also by a significant "spurt" of the electric field.

WHAT IF A COMMERCIAL EXPLOSION IS USED?

The obtained results, however, needed to be checked and verified--are they accidental or not? But to organize a new experimental explosion is expensive. Then it was decided to make use of commercial explosions, which are used, for example, during the construction of canals. In order to produce such explosions, frequently up to 1,000 tons of explosive are used. With respect to the magnitude of the energy discharged upwards, they are comparable to the MASSA program explosion.

The specialists from Soyuzvzryvprom [commercial explosions trust] managed to set off all the explosions at previously calculated moments of time so that there were coordinated measurements from on board the spacecraft and from the ground stations. The accuracy amounted literally to several seconds. And the the scientists were convinced that the explosion effects obtained in the MASSA experiment were not accidental. At the same time, it turned out that the phenomena of low frequency oscilations caused by the explosion persisted at least 35 minutes after it. And the dimensions of the area of intense oscillations of the ionosphere's electric field increase with a velocity of more than half a kilometer per second.

Thus, the experimental data regarding the effects in the ionosphere and the magnetosphere caused by ground explosions of average magnitude prove convincingly that the anthropogenic effect of large-scale acoustic waves on the near-earth plasma is highly substantial. It is all the more possible to expect similar effects in the ionosphere and the magnetosphere as a result of significant earthquakes.

In order to be certain of this, first of all it was decided to make a detailed analysis of the characteristics of the plasma and of the magnetic and electric fields obtained from satellites when they have overflown the epicenters of earthquakes. The specialists examined a large number of measurements at the time of earthquakes and, in many instances, the satellites' on-board equipment recorded BURSTS OF LOW FREQUENCY RADIATION reminiscent of the type discovered at the time of the MASSA experiment.

The main thing is that it has been possible to establish that such noise radiation has been clearly recorded by the equipment not only after an earthquake, but also for some time prior to it.! At first it was even very difficult to believe this. Could it really be that phenomena occurring at magnetospheric altitudes so far from us could help in the prediction of earthquakes?

SEISMOMAGNETIC EFFECTS EXIST.

Once again, a detailed analysis was made of the measurements from the Oreol-3 satellite, which had most sensitive equipment on board. Here is one of the examples of the observations. On revolution 2441, the satellite passed 3 degrees to the west of an epicenter at 4 hours and 40 minutes before an earthquake. At the same time, the equipment noted a brief burst of radiation. On the following revolution, 2442, Oreol-3 was located approximately 30 degrees to the west of the epicenter at 2 hours and 51 minutes before the moment of the earthquake. The amplitude of the burst had increased and it was observed over the course of a minute and a half. On revolution 2443, the satellite was 57 degrees to the west of the epicenter. Nevertheless, even at such a distance, the equipment recorded a burst of low frequency radiation over the course of three minutes. At 7 minutes after the earthquake, the spacecraft was 84 degrees to the west of the epicenter and, over the course of 3 minutes, radiation was observed which was typical for "after an earthquake." Thus, the burst of noise was noted FOR SEVERAL HOURS PRIOR TO THE START OF THE EARTHQUAKE and the observation zone was sufficiently extensive.

Up to the present time, data has been obtained on several dozen instances of satellite recordings of electromagnetic noises in the magnetosphere which are associated with the effects of significant earthquakes. Although the statistics and the detailing of such instances are still inadequate for the time being, the very existence of SEISMOMAGNETIC EFFECTS, observed both after an earthquake, as well as for several hours prior to it, has been reliably established. Thus, a principal opportunity has emerged for the establishment of a global system for observing the electromagnetic and seismomagnetic effects. However, it is still necessary to do a lot of work in order to make such a system a reality.

In the first place, it is necessary to continue measurements above seismically active zones, using spacecraft for this purpose. A set of on-board instruments suitable for this goal will be installed, in particular, on satellites developed currently for project INTERBOL. The project provides for placing into orbit at the end of the eighties two PROGNOZ-type spacecraft in order to conduct simultaneous research on the parameters of the plasma and the electric and magnetic fields and accelerated particles in the various regions of near-earth space. Each of the Prognoz craft will have its own small subsatellite. Simultaneous measurements from the satellite and the subsatellite of the one and the same parameters will make it possible to separate their space and time variations.

It is important also to continue satellite measurements of the seismomagnetic effects which arise during commercial explosions. Of particular interest is the coordination of the active experiments with the measurements from satellites planned to be launched for project Interbol. Taking into account the peculiarities of the satellites' orbits, this would make it possible to conduct a study of the explosion's effects simultaneously at different points of near-earth space and to track their propagation in the magnetosphere. All this will yield an opportunity for developing scientific method and data bases

for the realization of a global system for observation of the seismomagnetospheric phenomena using satellites. In the first place, it is necessary to develop specialized on-board equipment and measuring methods. A set of instruments can be installed in the future on suitable spacecraft in order to carry out regular patrol measurements or monitoring. It is very important during the implementation of monitoring to ensure the on-board processing of the date in accordance with previously established criteria. This will make it possible to discover in advance the seismomagnetospheric effects caused by an imminent earthquake, to determine their characteristics and will help to give a timely prediction and notification to the people of regions threatened with disaster.

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SPACE APPLICATIONS IN GEOGRAPHY

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[Article by A. M. Grin, Candidate of Geographical Sciences: "The 'Cosmic' Possibilities of Geography"; first paragraph appears in boldface in source]

[Text] "As the Earth's surface is being photographed from the Salyut-7 station, a survey of the Earth is being conducted by artificial earth satellites, flying laboratories, and helicopters, and ground-based observation points are helping out." These and other reports like them may no longer surprise anyone. But behind such routine phrases as these lies an entire phase of the development of the science that studies the surface of the Earth--geography.

The 'Cursed Points' Are Overcome

From time to time, the development of science provides proofs of the basic principles of the Marxist-Leninist dialectic that are striking in their clarity and conciseness. Such is the case with modern geography. Striving to keep in step with the age of the scientific and technical revolution, geographers have done their best in recent years to replace the "graphic descriptions" that had been so customary of the sites they study with quantitative values obtained with means and methods used by the "precise" sciences--primarily physics and chemistry. And the same goes for the "images of geosystems" and their condition. The addition of space-based techniques to science's arsenal for studying the Earth's surface has made it possible for geographers to obtain an "image" of whatever natural or economic complex they are studying that is measured within an extremely wide range of electromagnetic waves, including not only the entire visible-optical range, but also those far, far beyond it--those encompassing thermal and radio emissions.

Such an "image" provides a wealth of information about a natural target. What is extremely important, however, is that this is not information about a specific point on the surface of the

Earth, as it was when geographical studies were conducted with traditional ground-expedition methods or even the more modern stationary methods; rather it is at once information about a given geographical space--a geosystem whose size depends on the altitude of the survey and the resolution capabilities of the instrument used for the measurement. In fact, a point on an image produced by a survey conducted from an altitude of several hundred kilometers will represent at least several hundred square meters, if not kilometers, on the Earth's surface. Thus, with no effort on the part of the observer, a tremendous difficulty is overcome in correctly describing any geographic target whose principal feature is that it has area, or territory. It was not so very long ago when the usual ground-based research techniques actually measured parameters in points, which had to be used to characterize an entire region. Those "cursed points" (as geographers have expressively named them) hovered perpetually over the final outcomes of geographical research. Of course, the scientists were not sitting with their arms folded, waiting for "manna from heaven": they devised a multitude of techniques for overcoming this "curse," above all, maps. On the maps, they used observations made at specific points to construct lines representing the distribution by region of identical magnitudes (isolines), and they isolated regions with identical or similar properties. Geographers adopted photographic methods of studying land forms rather long ago.

As early as several decades ago, phototheodolite survey--a prototype of modern remote sensing--was used to study the movement of glaciers and detrital materials on mountain slopes. Dragging a heavy tripod and an unwieldy device that combined the theodolite and the camera, one had to negotiate dizzying ascents and equally complex descents just to make one or, at best, several photographs of the target area. And the price of that meager amount of information was extremely high. Tragic accidents with heavily loaded travellers on untrodden routes in the mountains were routine. Aerial photosurvey of areas was also evolving. All of the modern topographical maps of the country are constructed from photographs taken from aircraft. Without aerial survey, we could not even think of making detailed, accurate maps of all the sparsely populated, difficult-to-reach regions, of which there are so many in our country--regions that are in the high mountains, in the far reaches of the taiga, or in the arctic desert. But such maps exist now. And with little thought about how they were made or who made them, everyone uses them--from the construction engineers on the Baikal-Amur Line to the captains of nuclear icebreakers clearing a way to the North Pole to tourists of every stripe and class. Surveys conducted from aircraft flying at an altitude of 5-8 km, however, could not produce a radical change in geographical research methods. The information obtained with aerial photosurvey was limited in space and, most

important, in time and content. And all (or almost all) targets of geographical study are extremely dynamic: their physical state is changing constantly--over periods ranging from seconds to millennia, but nevertheless constantly. The information on the condition of, for example, wheat fields, even if collected over a period of just two or three weeks (which, all in all, could not be done in a country such as ours, because of the small area represented by an aerial photo taken at such altitudes) is useless or of little value to the directors of an agroindustrial complex, since either it would be too late to save it, the wheat, from disease or drought, if they existed, or the wheat would all be gathered and the only information anyone would need would be on size and quality of harvest. And the same went for practically all the changes in a geosystem associated with the growth and development of plants. A similar picture also emerged for various hydrometeorological phenomena--rivers overflowing their banks, catastrophic movements of glaciers in mountainous regions, and the movement of air masses over large areas of the country. Almost all aerial images were obtained in the visible range of the spectrum, which does not provide enough information for studying the dynamics of geosystems.

Aerial photosurvey was best suited for cartography depicting on topographic maps the stablest of geographic forms, those representing the, as a rule, extremely slowly changing relief of the Earth: mountains and plains, hills and river valleys, the shores of seas and oceans; growing but "stationary" population centers of all sizes, from megapolises to isolated farmsteads; railroads and highways; lakes and rivers; and the many, many other things that make up the topographic map of a region. Using aerial survey photographs to compile a map of a country such as the USSR, however, is a task of the greatest complexity in terms of science, technology, and especially economics, one that requires much--very much--time and a huge material expense. In the course of these operations, instruments and techniques have been devised that have turned out to be very, very useful when we began studying the Earth from space.

The Earth from Space

The initial findings of the study of the Earth from space were stunningly interesting. Of course, fractures of the Earth's surface that, from observations made on earth, had seemed to be separate formations unrelated to each other appeared from space to be geological structures that were extremely ordered and spanned great distances, and the individual elements of river and gully erosion [ovrazhno-balochnaya] systems on the plains came together in many locations into true ring structures. Colossal ocean circulations were observed that engulfed

unimaginable volumes of seawater (scientists had only predicted the existence of such circulations by analogy with atmospheric circulations--cyclones and anticyclones). All this was easily discernible from space. And the cyclones and anticyclones themselves, whose mechanisms of origin and existence had up to that time been discussed by only specialists, were now familiar to everyone, who, watching the weather forecast on television, had more than once seen satellite photos of cloud systems.

And it was not just pictures--it was also excellent raw data for organizing mineral prospecting or compiling weather forecasts; it was nothing less than that which gave the earth sciences their first look from space. It was the basis for a new scientific focus--space-based physical geography [kosmicheskoye zemlevedeniye], a branch of geography that studies the more general patterns of the structure and existence of the geographic crust of the Earth. As a result, the Institute of Geography of the USSR Academy of Sciences, in collaboration with dozens of other scientific and production institutions, was able to organize a grand undertaking--the publication of a new geographic world atlas, which, thanks to the satellite photos of the Earth, was more accurate (considerably so!) than all the previous editions of its kind. Within the context of joint efforts based on this very work, national atlases are being created for Mongolia and Vietnam.

But as they say, the appetite comes with eating. Satellite technology is ever so widely expanding the horizons of geography in other areas, too: it makes it possible to obtain information on the state of natural complexes--geosystems--continually and over practically any time interval required. For modern geography, this is perhaps no less important (it may even be more important) than the first still [odnomomentnyye] photos of the globe taken by satellite. This is especially so since information not at all confined to the optical spectrum has begun to arrive from space: unlike the human eye, instruments mounted on space vehicles pick up the reflective emissions of the Earth's surface at all wavelengths, from thermal (infrared) emissions to radio emissions, in narrow spectral zones, which drastically increases the possibilities of later analysis of the images, which are electromagnetic "images" of geosystems.

The 'New' Geography

In a broad sense, the second half of the twentieth century has prompted geography to radically reexamine its aims and the methods it is using to reach them. The principal requirement made of geography for the past one hundred years has been that it observe, conscientiously describe, and, when possible, explain. But now the social order issued by society, which has

entered the age of the scientific and technical revolution and which, in its interactions with nature, has become, in the popular words of V. I. Vernadskiy, a "geological force," has placed before the ancient science a number of complex tasks: participation in the drafting and design of plans for using natural resources and conditions, plans that differ in scale and time, but are always essential and critical in terms of their outcomes; forecasting (and often over quite a long range!) the state of various geographical forms; development of the geographical aspects of managing the interactions in a population-economy-natural environment system. Hence the "structural geography" [konstruktivnaya geografiya] of Academician I. P. Gerasimov, which was designed to solve these problems.

Moreover, scientitic development and the new measuring and computing capabilities taken from related sciences have prompted geography to use the systems approach in its studies. In her "Learning About Geosystems," V. B. Sochava synthesized these new theoretical concepts of geography.

Remote techniques of studying the Earth can provide numerically precise information about an area of practically any size--from an individual enterprise or agricultural field to an entire hemisphere--with any requisite frequency. The matter, however, is not as simple as it would seem at first glance. The data, as we have already said, is available to the specialists in the form of electromagnetic (spectral) "images" of specific geosystems of various scales and in specific physical states. How does one grasp what this image represents? The task turned out to be complex and time-consuming. Geography had to use the experience of practically all the physical and engineering sciences that deal with analysis of electromagnetic reflective emissions.

'Kursk-85'

One of the most important means for achieving this goal--interpreting the content of the remote-sensing information--were complex, multi-level experiments carried out at specialized testing grounds. The Kursk-85 international experiment illustrates what such activities provide.

The Institute of Geography of the USSR Academy of Sciences has long been collaborating in the Kursk region with many other natural history institutions and organizations. The base of operations has been the Kursk model region (which makes up nearly 80% of the Kursk oblast, in the catchment basin of the Seym River), chosen by geographers of the CEMA countries as a focus of research of man's effect on nature. The key sector of the area where the most detailed research is carried out is the

Central-Chernozem State Reserve im Professor V. V. Alekhin, a unique natural plot of virgin forest steppe in that it is a naturally occurring combination of meadow steppe and watershed oak woods [vodorazdelnyye dubravy]. Here the effect of man on the environment is minimal. It can arbitrarily be taken to represent "zero" in all the subsequent analyses of the magnitude of such an effect. Observations are also made on the agricultural fields that surround the reserve; in the cities of Kursk, Zheleznogorsk, and Kurchatov; at the Mikhailovskoye Ore-Dressing Combine, with its large iron-ore pit; and at the Kursk Nuclear Power Plant, with its large cooling reservoir. The extent and depth of the operations predestined the reserve, along with the institute's Kursk Biosphere Station created here, to be included in an international network of biosphere reserves, and the broad possibilities for conducting methodological operations in this well-studied area so characteristic of Central Russia turned it into one of the country's aerial photography testing grounds.

'A Multi-Tiered Bookstand'

In the summer of 1985, specialists from seven socialist countries stayed here for nearly an entire month. They were participants in an international target complex project called "Using Remote Techniques to Study the Dynamics of Geosystems," which was conducted within the framework of the Intercosmos program. Automobiles carried international groups of specialists--biometrists, microclimatologists, hydrologists, and soil scientists--into the field. The "first level" of the remote-sensing instruments consisted of spectrometers that were from the various countries and were lifted above the ground on tripods and on the towers of specially outfitted vehicles. Helicopters and AN-2 aircraft took off, and this "second level" surveyed with similar spectrometers and with radiometers, infrared imagers, and multi-channel cameras. The "third level" worked at high altitudes: TU-134SKh and AN-30 flying laboratories with instruments that were analogs of those used on the space vehicles that provided the "fourth level" of the remote sensing. The space vehicles were Meteor-type artificial earth satellites, satellites of the Cosmos series, and the Salyut-7/Soyuz T-13 orbital complex.

The international collectives of spectrometrists, radio- and thermophysicists, and photometrists effected the successful operation of the measurement gear on all the "levels," with the exception this time of the space level (although members of the "space family"--Hungarian cosmonaut B. Farkas and Soviet cosmonaut V. V. Kovalenok--worked effectively on the ground, at

the "first level" of remote sensing). Their instruments measured the multiple characteristics of plant and soil cover, the water reserves in the ground, and the surface temperature of the plants, the soil, and water bodies.

Such a concentration of efforts at one extremely dynamically developing site--fields of wheat, barley, corn, sugar cane, and perennial grasses--provided all the arsenals of remote-sensing gear and methods of ground-based biometric, geophysical, and geochemical observation the unique possibility of measuring the basic characteristics of this agricultural geosystem while it

Participants in the Kursk-85 experiment--specialists from various countries collaborating in the Intercosmos program--calibrate their spectrometric instruments, which will be used to conduct measurements on the first three levels of the "multi-tiered bookstand."

was growing. That is, to identify the trajectory, as it were, of the change of its state over time and to open to agronomists the possibility of constructing a forecast of harvests.

Kursk-85 represented the creative, practical union of science and production. The experience acquired in this experiment will serve as the basis for an all-union system that is being created to monitor crops. Only with information obtained in space and properly interpreted can we, in using technology and material resources, control large areas of crop disease and the effects of local drought and other natural disasters, manage the timely

Cosmonauts V. V. Kovalenok (center) and B. Farkas (right) during ground-based remote-sensing operations

harvest of maturing grains in large regions of the country, and do much more in the complex system of the agricultural industry. The Kursk-85 participants not only made observations with their instruments, but also exchanged the data of their measurements and of the methods of their initial analysis. They calibrated their instruments to each other's--and now measurements made in any of the socialist countries can be easily correlated and can be used in any country. In an effort to strengthen the work of the joint operations, Soviet scientists not only made all the laboratories and the computer center of the Kursk Biosphere Station available to the scientists from the other countries, but also conducted two series of observations themselves--one in May, just after the take-offs, and one in July, just before the grain harvest. All the materials that were obtained in those observations were given to the other Kursk-85 participants.

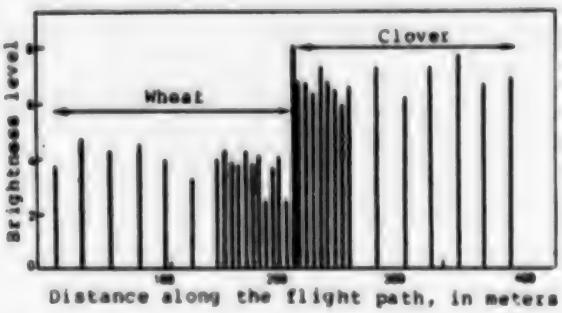
The directors and participants of this international experiment did have their alarming days. The operation of the Salyut-7 orbital station was, of course, included in the Kursk-85 program. Everyone knows by now how much bravery and intelligence was required of the great "Pamirs" V. A. Dzhanibekov and V. P. Savinykh in order that the words quoted in the beginning of this article would appear in the Flight Control Center communications.

Initial Findings

Sometime later, the Kursk-85 participants began to analyze the data they had obtained and build the system so necessary for scientists and technicians to interpret remote information on agricultural geosystems. As early as the spring of 1986,

scientists of the member-countries of Intercosmos gathered in Moscow and were able to discuss the initial findings of the analysis of the Kursk-85 materials. Soviet specialists displayed graphics as one of the examples of the successful use of a flight-path spectrometer.

The first of them demonstrated the possibility of clearly distinguishing between fields planted with different crops--the instrument responded almost instantly to the change from wheat that was "green" at that time to clover that was just as "green." For the instrument, however, their "greenness" was different--the brightness of the two images differed on average by no less than two units of measurement (the wheat was roughly 5, and the clover was roughly 7), and there was not even one brightness level in the wheat that matched any of those measured in the clover. Thus, total reliability was achieved in identifying the wheat field and the clover field on the image that was made.

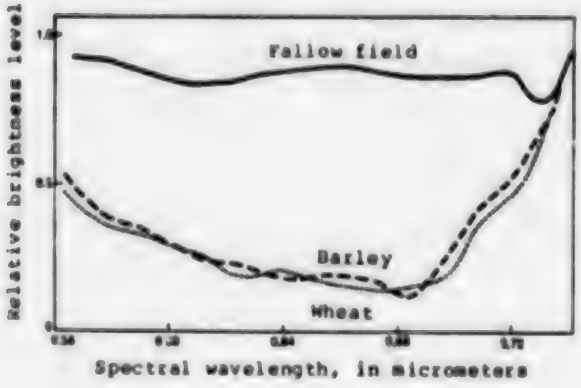


Spectral energy characteristics of two agrosystems, obtained in the course of measurements made aboard an aircraft with gear similar to the gear aboard the Salyut-7/Soyuz T-13 orbital complex. Analysis of such graphs makes it possible to evaluate the condition of a given system--biophysical characteristics such as the stage of development of the crop, its color and the biomass of the plant cover, and the moisture content of the plant growth and the soil

The second graphic enables a finer analysis on the basis of this method. It is apparent that the most informative wavelength range (in terms of solving problems involving breaking images down by crop) is between 0.62 and 0.69 micrometers, where the contrasts of the relative brightness reach their highest values. On combined spectrozonal [spektrozonalnyye] photos, Hungarian specialists demonstrated the possibility of evaluating the moisture content and condition of a biomass of agricultural fields. The redder the image, the larger the biomass of plants on those fields; and where there were no plants, the blacker the image, the higher the moisture content of the soil lying fallow.

"GEOEX-86"

Kursk-85 is not the last experiment to have been conducted on the difficult road to the effective use of remote geographical information in science and in the economy. In 1986, similar



Spectrograms of three typical agrosystems of the Kursk Aerospace Testing Ground, obtained with a flight-path spectrometer--a model similar to the one aboard the Salyut-7/Soyuz T-13 complex. The difference between grain crop planting and the fallow field is clear. The difference between the barley and the wheat is less apparent, but can be easily determined with computer analysis

work was done in GDR in the GEOEX-86 program. An international collective studied regions that had high concentrations of population and industry and a vigorous agricultural economy. Unlike at Kursk, where a single area of the testing grounds was studied, the German scientists conducted their work at four test sites in different parts of GDR. The most interesting were two test sites whose soils had substantially different moisture contents: one was dry and sandy; the other however, saturated with moisture, was even marshy in places. Both were under heavy agricultural production. Analysis of the materials collected here will enable yet another step toward achieving the primary goal of the project--to create a space-based system that effectively tracks the condition and development of natural and anthropogenic geosystems across large regions within countries of the socialist concord.

A Space-Based Monitoring Service

In store for geography and related sciences are tasks of even greater importance and concern, among them the use of information gathered in space to create a geosystem monitoring service--a system for tracking the condition of all natural and economic complexes of the country (and later, the world) for the purpose of preparing data to be used by the agencies that monitor, forecast, and control that condition. But before such a system can begin to work, geographers must do a colossal amount of work in developing the scientific principles for interpreting the content of remote-sensing materials and must build advanced operational and predictive models of growth. And then the most difficult--controlling the condition of the basic geosystems of the Earth. But all this is possible only if it is based on information gathered in a peaceful outer space.

13227
CSO: 1866/94

UDC 528.16

METHOD FOR JOINT ADJUSTMENT OF SATELLITE AND SURFACE GEODETIC NETWORKS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 5, May 87 pp 12-15

[Article by B.M. Klenitskiy, K.K. Nasretdinov and M.M. Khotin]

[Abstract] The purpose of joint adjustment of satellite and surface geodetic networks constructed in different coordinate systems is to obtain adjusted coordinates of stations in each network, taking into account the results of adjustment of the other network and transformation elements in such a way that the adopted coordinate systems are not changed. An effort has been made to develop an adjustment method which takes maximum advantage of newly available methods for processing measurements of extensive geodetic networks with minimum need for additional software. The proposed algorithm is readily integrated with traditional schemes for adjustment of such networks, such as the Pranis-Pranevich method, with solution of normal equations by the successive exclusion of unknowns. In comparison with the known method for integrating solutions, based on summing of the weighting matrices of individual networks, the new method does not require a procedure for obtaining a weighting matrix for the initial station of the surface geodetic network because it is based on the summing of correlation matrices. Another advantage of the method is the possibility of more precise stipulation of the covariation matrices obtained by independent solution of individual systems in the course of solution of the pertinent coupling equations. It is now possible to improve the relations of correlation matrices for geodetic networks constructed by different methods whose real accuracy is not always reflected when using the least squares method. References: 4 Russian.

5303/8309
CSO: 18660105

UDC 551.501.7

METHOD OF DETERMINING ATMOSPHERIC MOISTURE CONTENT BY MEASUREMENT OF UPWARD RADIATION INTENSITY IN NEAR IR

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 20 Nov 84; after revision 8 Aug 86) pp 44-50

[Article by Ye.V. Ovchinikova]

[Abstract] Two bands are selected for measurement of upward radiation intensity: 1.8-1.30 and 1.20-1.27 μm. Since the properties of the atmospheric aerosol are practically identical in these two bands, the ratio of intensities of upward radiation in these intervals measured by observing a small object on a homogeneous surface must be primarily determined by the molecular transparency of the atmosphere. Since this transparency is determined by the absorption of water vapor in the 1.8-1.30 μm interval, the ratio of measured intensities can be used to determine the adjusted moisture content of the atmosphere. An equation is presented for determination of the adjusted moisture content based on measured changes in upward radiation intensity in these two bands. The error computed for a statistical average atmosphere in summer in the middle latitudes is 12 percent for observation of objects not over 300 m in diameter.

Figures 5; references 15: 12 Russian, 3 Western

6508/8309
CSO: 18660093

UDC 551.507.362:551.466.31

LIMITING ACCURACY OF SCATTEROMETER DETERMINATION OF WIND SPEED OVER OCEAN FROM SATELLITE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 13 Nov 85) pp 57-65

[Article by G.N. Khristoforov, A.S. Zapevalov and V.Ye. Smolov, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] Studies of recent years have shown that the spectral density of high frequency components in wind waves increases with increasing wind speed over the ocean. These results can in principle be used as a physical basis for a method of radar determination of wind parameters over the ocean. In order to determine the genuine accuracy of single-parameter reproduction of the wind field, one must estimate the contribution of the major components of the statistical error. This article attempts to isolate that portion of the error determined by the actual nature of the amplitude relationship of wind ripples with the fluctuations of the wind parameters in the lowest layer of the atmosphere. It is demonstrated that this component of the total error creates a basic limitation on improvement of the accuracy of remote measurement of wind speed over the ocean, particularly where wind speed is less than 4-5 m/sec. Where wind speeds are 4-17 m/sec, the limiting accuracy is about ± 1-2 m/sec. Figures 3; references 15: 10 Russian, 5 Western

6508/8309
CSO: 18660093

UDC 528.94+551.24:629.78

SPACE PHOTOGRAPHS OF THE ONEGA-LADOGA ISTHMUS AND PREDICTION OF USEFUL MINERALS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 9 Jul 85; after revision 3 Jan 86) pp 66-72

[Article by Z.A. Bagrova and I.B. Antonova, "Sevzapgeologiya" Production Geological Association]

[Abstract] Space photographs of the Onega-Ladoga isthmus, in various scales and with various levels of generalization, were interpreted and correlated with known geological-geophysical information to construct a new geological-structural map of the area. The work was performed in two stages: Actual interpretation of the space photographs, entering all information on a map; and interpretation of the data obtained and comparison with previously known information. The space photographs assisted in the production of an objective model of the structure of the area.

Figure 1; references 10: Russian

6508/8309
CSO: 18660093

UDC 550.814:551.25:629.78

USE OF SPACE PHOTOGRAPHS FOR GEOMORPHOLOGICAL STUDIES IN SOUTHWESTERN TAJIKISTAN

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 12 Dec 85; after revision 10 Jun 86) pp 73-80

[Article by V.P. Loziyev and M.S. Saidov, "Priroda" State Scientific Research and Production Center]

[Abstract] Since 1977, complex studies of natural resources in Tajikistan have been performed based on space survey materials, space photographs of varying levels of generalization obtained on board the "Salyut" manned spacecraft and the "Cosmos" automatic spacecraft. The results of these studies have shown that the materials of space photographic surveys can be successfully used for geomorphological mapping. The materials can be used in many cases to reproduce relief forms which have been destroyed by human economic activity and recognize buried elements which determine the lithologic and structural characteristics of sedimentary basins. The quality of "transparency" of the photographs allows determination of certain deep structural elements not observed by visual mapping. A table illustrates the relationship of recent tectonic movement and development of epiplatform relief in the area.

Figures 3; references 6: Western

6508/8309
CSO: 18660093

UDC 528.77:550.814:551.243.13+629.78(517.3)

USE OF SPACE PHOTOGRAPHS FOR PALEOSEISMOGEOLOGICAL STUDIES (ON THE EXAMPLE OF MONGOLIAN ALTAY)

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 21 Apr 86) pp 81-84

[Article by A.L. Strom, "Gidroporoekt" Institute, Moscow]

[Abstract] A study is made of the possibility of using space photographs in paleoseismogeological studies of the Mongolian Altay region. The photographs revealed the largest paleoseismogenic structures almost as clearly as contemporary seismic dislocations. The tremendous areas covered by the space photographs reveal clear traces of fractures framing individual lens-shaped blocks 10-40 km in width. The examples presented demonstrate that space photographs can be successfully used to find and study ancient seismic dislocations in Central Asia, allowing rapid and complete examination of large areas, revealing traces of ancient earthquakes and the interrelationships of individual ancient seismic dislocations, and their position relative to elements of the ancient and particularly the recent tectonic structure.

Figures 2; references 6: 5 Russian, 1 Western

6508/8309
CSO: 18660093

UDC 551.4.712

STUDY OF RELIEF OF ORE REGIONS USING SPACE IMAGES (ON THE EXAMPLE OF EASTERN YAKUTIA)

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 3 Mar 86) pp 85-89

[Article by V.A. Balandin, Institute of Northern Mining, Yakutsk Affiliate, Siberian Division, USSR Academy of Sciences, Yakutsk]

[Abstract] A study of many mining regions of Eastern Yakutia has shown that most of them coincide with areas of granitoids, associated with circular formations produced by endogenous structure-forming factors. The method of locating these formations from space photographs is simple, involving a search for concentric sectors of divides and valleys, arch-shaped image elements associated with changes in facies and intensity of jointing, isometric and arch shaped landscape zones and other similar characteristics. Ore zones are usually found around the outer contour of local circular formations or are associated with radially concentric cracks at their centers. The circular formations and lineaments of meridional, latitudinal and diagonal directions are found to be ore-controlling characteristics. The space photographs agree with, but are more diagnostic than, structural-geomorphological constructions in locating ore zones.

Figure 1; references 15: Russian

6508/8309
CSO: 18660093

UDC 528.813

STATISTICAL MODEL OF INTERACTION OF ELECTROMAGNETIC WAVES WITH NATURAL OBJECTS BEING SENSED

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 4 Sep 85; after revision 17 Mar 86) pp 90-95

[Article by V. V. Yegorov, Institute of Space Research, USSR Academy of Sciences, Moscow]

[Abstract] A study is made of a model of objects being sensed and the processes of interaction between the objects and the sensing electromagnetic field, utilizing models of tropospheric and ionospheric scatter communications channels. A statistical method of analysis is used, assuming scattering of the field to be Gaussian with zero mean and noncoherent summation of partial fields. The model includes the pulse response of the transmission path, which is demonstrated to be influenced by the spectral reflection properties of the object being sensed. Determination of the transfer functions of all elements involved in remote sensing makes possible a description of the entire monitoring loop and control of the status of natural and man-made objects.

References 8: Russian

6508/8309
CSO: 18660093

UDC 535.361+57.084.2:535.232.65

MONTE CARLO METHOD CALCULATION OF SPECTRAL BRIGHTNESS COEFFICIENT OF VEGETATION COVER AS FUNCTION OF ILLUMINATION CONDITIONS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 24 Sep 85; after revision 13 Aug 86) pp 96-105

[Article by Yu.K. Ross and A.L. Marshak, Institute of Astrophysics and Atmospheric Physics, Estonian Academy of Sciences, Tartu]

[Abstract] Results are presented from calculation of the variation of spectral brightness coefficient or index of reflection of a model of a vegetation cover as a function of the viewing direction. The influence of repetition of scattering and the fraction of scattered sky radiation in the total incident solar radiation is estimated. The variation of spectral brightness coefficient with zenith angle, azimuth of the sun and brightness of the soil is analyzed. Calculations are performed for the area of photosynthetically active radiation at 380-710 nm. Vegetation is modeled by horizontal matte leaves and vertical nontransparent stems. It is found that the model can be limited to one-time scattering, multiple scattering increasing the brightness by only 5 percent. The indices of reflection calculated for total and direct solar radiation differ little. The index of reflection used is close to that of a matte surface except in the area close to the opposite direction from which the solar rays are coming and those near the nadir. The behavior of the index near the nadir depends on the difference in optical properties of plant elements and the soil. If the soil is darker than the leaves, the index has a minimum at the nadir, if lighter--a maximum.

Figures 6; references 6: 2 Russian, 4 Western

6508/8309
CSO: 18660093

UDC 681.425.5:528.851

MODELING OF ARCHITECTURE OF A PROBLEM-ORIENTED ON-BOARD PROCESSOR

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 13 Dec 85; after revision 3 Apr 86) pp 112-117

[Article by M.A. Aliyeva, V.N. Vintayev and K.Kh. Ismailov, Scientific-Production Association for Space Research, Azerbaijan Academy of Sciences, Baku]

[Abstract] A problem-oriented conveyor processor with software-modifiable configuration is suggested for on-board processing of multizonal images. The basic operational unit of the processor is a conveyor computing line. The basic module of the processor is a set of four such lines, switched arbitarily to produce series or parallel circuits by means of a 4-channel switch. Each computing line includes RAM, an input functional converter, a service register set, a conveyor multiplier-adder, an adder-accumulator, and a normalizing register and output functional converter. High throughput and functional completeless are sought by designing for functional freedom with the minimum number of hardware modules utilizing MSI microcircuits.

Figures 2; references 6: Russian

6508/8309
CSO: 18660093

UDC 53[illegible].8:629.78

MULTISTEP COMPONENT ANALYSIS OF CORRELATIONS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 87 (manuscript received 29 Jul 85) pp 118-122

[Article by V.A. Kottsov and E.A. Gorbushina, Institute of Space Studies, USSR Academy of Sciences, Moscow]

[Abstract] The difficulty of processing the results of multizonal imaging of the Earth increases more rapidly than the number of spectral bands used. The method of principal components has been successfully used to reduce redundancy by replacing low-value correlation coefficients in the correlation matrix with zeros, thus isolating the principal components. The method suggested in this article can be used to estimate the variability of the structure of the principal components, optimizing the selection of combinations of observed parameters to increase the reliability of estimates produced. Multistep component analysis allows the volume of information used to be expanded.

Figures 3; references 11: 10 Russian, 1 Western

6508/8309
CSO: 18660093

UDC 528.225:629.783

NEW POSSIBILITIES FOR USING GRAVITY DATA IN DEVELOPING GEODETIC COORDINATE SYSTEMS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 3, Mar 87 pp 10-13

[Article by L.P. Pellinen]

[Abstract] Major advances have been made in using the orbital satellite method for determining points on the earth's surface in improved reference systems, especially when using laser observations. Still another method for finding geodetic height $\overline{H}$ is afforded by gravity data (harmonic geopotential coefficients obtained by satellite orbital and radio altimeter determinations, characterizing Earth's gravity field and gravity anomalies). The procedures used for this purpose are outlined. A formula is derived for determining the height anomaly ζ from gravity anomalies. The principal advantage of the proposed method for processing geodetic networks in comparison with traditional methods is that use is made of height anomalies ζ which are entirely free of the indirect influence of errors in geodetic coordinates, the main source of systematic distortions of height anomalies determined using astronomical or astrogravimetric leveling (which retains its importance in processing geodetic networks only within or near gravimetrically poorly studied regions). With an increase in accuracy in determining the η component of plumb-line deflection on the basis of gravity data it will be possible to make an independent determination of astronomical longitude. In the future, by determining ΔH_0^{κ} values by the proposed method for leveling networks unconnected to one another, using the ΔH_0^{γ} differences it will be possible to determine the relative vertical positioning of the zeroes of different height systems. References 6: 2 Russian 4 Western

5303/8309
CSO: 18660108

SPACE APPLICATIONS

UDC [528.711.4:621.396.969]:523.42

PROCESSING OF RADAR IMAGES OF VENUS ON THE 'MAGISCAN-2' ANALYZER

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 2, Feb 87 pp 51-55

[Article by A.Ya. Danil'chenko, M.S. Markov, M.V. Ostrovskiy, Yu.S. Tyuflin and D.Ya. Choporov]

[Abstract] In order to automate the process of geological interpretation of the results of radar surveys of Venus, an attempt was made at machine isolation of tectonic structural elements of the planet by analysis of relief structure. Since the position and strike of linear elements correspond with the position and strike of large relief formations, the task was performed by means of an algorithm which isolated structural relief elements on radar images. Two methods can be used: The position and strike of lineaments are determined from the axial lines of large relief elements; the position and strike of lineaments are determined from the position of the axial lines of relief forms, which do not always precisely coincide with the basic elements of the tectonic structure but are always parallel to them in strike. The task at hand is fairly simply solved by means of an algorithm based on isolation of the slopes of large relief forms of the planets using negative sectors of the radar image with subsequent determination of axial lines, corresponding to the position and strike of lineaments in the relief of the planet. A British "Magiscan-2" device was used to process corrected photo maps. Images were input by means of a high resolution video camera with 64-level gray scale. The operator interactively generated a symbolic graphic image of the information structures to determine the position of the lineaments.

Figures 5; references 8: 5 Russian, 3 Western

6508/8309
CSO: 18660076

SPACE APPLICATIONS

KIRGIZ SSR EXPANDING UTILIZATION OF SPACE IMAGERY

Frunze SOVETSKAYA KIRGIZIYA in Russian 19 Jul 87 p 3

[Excerpt] Promising areas for oil and gas, glaciers that were previously unknown, energy potential of rivers, and lands suitable for development have all been discovered on the territory of the Kirgiz SSR while it was being viewed from space. A meeting of the commission for coordinating work in the field of comprehensive inventorying of natural resources of the Kirgiz SSR on the basis of space photographs has taken place in the capital of the republic. N.I. Semenov, secretary of the Central Committee of the Communist Party of Kirgizia and chairman of the commission, conducted the meeting.

It was noted at the meeting that during the period 1981-1987, the Kirgiz Academy of Sciences, a number of ministries, agencies and organizations of the republic, and the Uzbek branch of the USSR state center "Priroda" (nature) jointly carried out a substantial amount of work for studying natural resources of Kirgizia on the basis of employment of methods for remote sensing of the republic's entire territory from space.

For the first time in the republic, methods for comprehensive study and mapping of natural resources have been developed and tested in practice, special methods for interpreting space photographs have been tried out, and qualified scientific and industrial personnel have been trained and material-and-technical resources prepared for further research, as a result.

An interbranch center for collective use of space-photography materials has been created in the city of Frunze and equipped with the necessary instruments. A program of work for study of natural resources at the present stage, which was called for by technical plans and a coordinating plan, has been carried out in its entirety.

A proposal of the "Priroda" center was adopted in regard to the drafting by the center's Uzbek branch, in 1987, of scientific-technical plans and a coordinating plan-schedule for carrying out, in 1988-1995, work on studying natural resources of the Kirgiz SSR on the basis of space-photography materials, by agreement with concerned ministries, agencies and organizations of the republic.

Yu.P. Kiyenko, head of the "Priroda" center, took part in the commission's work and spoke at the meeting.

FTD/SNAP
/8309
CSO: 18660016

TASS REPORTS RADAR ABOARD 'COSMOS-1870', ORBITAL CORRECTION

Moscow PRAVDA in Russian 3 Aug 87 p 2

[TASS Report]

[Text] Flight Control Center, 2 August. The flight of the artificial Earth satellite "Cosmos-1870," which was placed into a near-Earth orbit on 25 July 1987, is continuing.

This satellite's set of scientific apparatus includes a radar unit intended for remote sensing of the Earth's surface and the world's oceans irrespective of weather conditions and the time of day, as well as instruments for studying flows of charged particles in near-Earth space.

Following a correction of trajectory of movement, the satellite's orbit parameters are: maximum distance from the surface of Earth--271 kilometers; minimum distance from the surface of Earth--254 kilometers; period of revolution--89.5 minutes; inclination--71.9 degrees.

The first periods of radar sensing of individual areas of land surface and the waters of the world's oceans took place today, in line with a program.

Information obtained with the aid of the "Cosmos-1870" satellite will be transmitted to institutes of the USSR Academy of Sciences and other concerned organizations for study and use in various branches of science and the country's economy.

FTD/SNAP
/8309
CSO: 18660016

FLAWS IN 'KOSPAS-SARSAT' SYSTEM CRITICIZED

Moscow SOVETSKAYA ROSSIYA in Russian 20 Aug 87 p 4

[Article by N. Dombkovskiy]

[Abstract] The article gives an account of an operation for rescuing the passengers and crew of an AN-2 airplane which had crash-landed in a remote area of the Taymyr National Okrug. The airplane was located with the aid of data received from an artificial Earth satellite of the "Kospas-Sarsat" system for aiding ships and airplanes in distress. This satellite picked up an emergency signal broadcast by a transmitter which the airplane carried.

Attention is called in this connection to shortcomings of the satellite-aided rescue system. The author complains: "The 'Kospas-Sarsat' system still falls far short of being adapted to our country's needs. Equipment installed in stations for receiving signals from space has not been perfected and does not allow coordinates of disaster victims to be calculated quickly and precisely. Rescue teams usually obtain this information from tracking stations of other countries. Moreover, malfunctions occur regularly in our stations' apparatus. Recent exercises employing 'Kospas-Sarsat' have demonstrated this graphically.

"One gets the impression that the people responsible for operating the Soviet part of the system were in too much of a hurry to report its commissioning. This is confirmed not only by the faultiness of ground stations' equipment but also by the fundamental approach that was taken to the system.

"It is no exaggeration to say that this system can be used by dozens of branches of the economy--by seamen, aviators, gas-industry workers, medical personnel, geologists and polar explorers. The Ministry of the Merchant Fleet is solely responsible for its operation, however.

"Moreover, the possibilities that 'Kospas-Sarsat' affords are not really accessible to Soviet users. Our country has never produced readio buoys for the system. "Fortunately, the AN-2 that crash-landed carried an emergency transmitter tuned to the satellite's frequency, and the accident occurred not far from a permanent airfield. But what is to be done by the many travelers who lack even such simple radio sets and whose routes take them thousands of kilometers from dwelling places and roads?"

FTD/SNAP
/8309
CSO: 18660016

SPACE POLICY, ADMINISTRATION

PRESIDENT OF ACADEMY OF SCIENCES COMMENTS ON 'ENERGIYA' BOOSTER

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 22 May 87 p 3

[Interview with G. I. Marchuk, academician, president, USSR Academy of Sciences, by a TASS correspondent, in connection with beginning of flight-design tests of new Soviet general-purpose "Energiya" booster; data and place not specified: "Formula for Space Acceleration"]

[Text] [Question] What is the role of Soviet cosmonautics in the development of science, technology and the national economy?

[Answer] Soviet cosmonautics plays a major role in accelerating modern scientific and technical progress. It makes use of advances in the most important branches of science and technology and at the same time stimulates their development, imposing high requirements on the rates of improvement in the technical level and quality of objects, instruments and apparatus which are produced.

Space systems are assuming ever-increasing importance as means for enhancing the efficiency of many economic branches. Space communication and television, navigational and meteorological systems have become firmly entrenched in our business and day-to-day life, seemingly bringing closer together the different regions of our motherland and all countries of the world. The study of the earth's natural resources from space has been transformed into an important practical task and in many respects is favoring the accelerated development of geology, cartography, geodesy, forestry and fishing, various branches of the agricultural industry, etc.

During the 30 years of the space era Soviet cosmonautics has made enormous advances. A broadly based program of scientific research for studying space and celestial bodies has been implemented successfully and there has been broad use of artificial earth satellites in the interests of economic branches. Several generations of artificial satellites, manned orbital stations and spaceships and automatic vehicles for exploring the planets have already succeeded one another. The prolonged flights of the Soviet orbital stations "Salyut" and "Mir" and the successful implementation of the international "Vega" program have won applause from the world community.

[Question] What is the role played by booster rockets in space exploration?

[Answer] In the realization of a wide-based program for space exploration for peaceful purposes an important role is played by the means used for launching space vehicles into circumterrestrial orbits.

The launching of the first artificial earth satellite and man's first flight into space, carried out using the Soviet-produced "Sputnik" and "Vostok" boosters, were historic landmarks in the development of Soviet and world cosmonautics.

A large part of the extensive space research program with artificial earth satellites of the "Cosmos" series is being implemented due to use of the economical and operationally simple booster of the same name.

Launchings of spaceships for replacing crews and for the material and technical supplying of manned stations, including flights of international crews under the "Intercosmos" program, are accomplished using the "Soyuz" booster, which is characterized by high design and energy qualities and a high reliability.

A great achievement in Soviet rocket construction was the production of the heavy "Proton" booster rocket whose use opened up a new stage in space exploration. This booster was used for flights of automatic interplanetary stations with landings of vehicles on the Moon, Venus and Mars, return of samples of lunar ground to the earth, launching of communication satellites into a geostationary orbit and launching of the long-lived "Salyut" orbital stations and stations of the third "Mir" generation. The greatest achievement was the implementation of the international "Vega" project for many-sided investigations of the planet Venus and Halley's comet, receiving high acclaim from the world scientific community.

New tasks, involving the industrialization of circumterrestrial space, are considerably increasing the demands on the space transport system with respect to increase in the freight to be carried into space, a decrease in specific expenditures on transport, a further increase in reliability and safety, assurance of descent of heavy freight from orbit and comfortable conditions for the return of cosmonauts to the earth.

[Question] Just what is the new general-purpose "Energiya" booster rocket?

[Answer] The "Energiya" booster is a two-stage rocket. It is designed in a "Paket" scheme with lateral placement of the payload to be put into orbit. Its first stage consists of four strap-on boosters. The second stage is a central block with a length of 60 m and a diameter of 8 m. The first-stage engines operate on oxygen-kerosene fuel; the second-stage engines operate on oxygen-hydrogen fuel. The "Energiya" booster rocket has a launching weight of more than 2,000 tons and can put more than 100 tons of payload into orbit.

Being a general-purpose booster, it makes it possible to launch both multiply used ships and other large-size space vehicles for scientific and economic purposes into circumterrestrial orbits.

[Question] What are the prospects for using the "Energiya" booster rocket?

[Answer] The bringing of the general-purpose "Energiya" heavy booster rocket on line is opening a new stage in the development of Soviet rocket-space technology in the program for research in space and its exploration for peaceful purposes.

The "Energiya" booster rocket is the main link in the multiple-use space transport system being organized in the USSR. We regard such systems as a promising means of transport and we are studying the problems involved in their efficient use for carrying out broad-based research and the systematically planned habitation of space.

It is known that Soviet scientists consider the main direction in space exploration to be manned orbital systems. Much experience has been acquired in operation of stations of the "Salyut" series and this confirms the correctness of the selected direction. The manned "Mir" system, in which the first of five specialized modules, the "Kvant" astrophysical laboratory, is now operating, represents a new step in this direction. Large new orbital stations are now being developed, as well as large modules for them. Accordingly, in organizing our repeated use space transport system provision is being made for the possibility of its joint operation together with highly promising manned orbital systems.

Use of the "Energiya" general purpose booster rocket will enable us to expand work considerably on the peaceful exploration of space, including the launching of heavy communication satellites into geostationary orbit and automatic interplanetary stations into distant space and to the sun, assembly of multipurpose orbital structures from large construction units and parts, and orbital deployment of experimental solar power plants with a great area of solar cells for the needs of space production. Thus, prospects are opening up for the industrialization of circumterrestrial space.

However, we have no intention of discarding the reliable booster rockets which have performed so well in the past and which we will continue to use in the future for the transporting of freight into space. An optimal combination of boosters of different classes, spaceships, interorbital "tugs" and other space apparatus will make it possible to organize a highly productive "Earth-space-Earth" transport bridge, which is an objective necessity for the development of cosmonautics.

[Question] Just how can you characterize the level of development of modern Soviet space technology?

[Answer] Soviet rocket and space technology is being developed through the work and talent of our people. Its basis was laid by Academicians S. P. Korolev, M. V. Keldysh, M. K. Yangel, V. N. Chelomey and N. A. Pilyugin, other outstanding scientists and engineers and leading specialists in many branches of science and technology. The enormous potential of the results of work of scientific research and designing organizations and production enterprises has been concentrated in cosmonautics.

At a meeting with workers at Leninsk, M. S. Gorbachev particularly emphasized that all space technology, ranging from the most complex launching structures, test stands and laboratories through powerful booster rockets and spacecraft and their life support systems, outfitted with modern computers, all have been designed and constructed in the USSR, all are of a high quality and are at a modern technical level.

Today cosmonautics can be regarded as a new field of technology which is an example for all branches of the national economy. We now very much need an example in which Soviet society has risen to the solution of new problems which cannot be dealt with using old methods, the old level of knowledge and professional training.

The experience of cosmonautics convinces and inspires the assurance that the Soviet people can handle the grandiose plans for revolutionary restructuring laid out by our party.

[Question] What are the further plans for the Soviet space program?

[Answer] At the basis of our space program is the profound conviction that wide-based international cooperation in the peaceful exploration of space is a constructive alternative to the plans for extending the arms race into space. Distinguishing features in our program are a broad scale and a realistic approach, expressed in the step-by-step realization of broad plans for space exploration at specific times.

The program is intended for uniting the efforts of the greatest possible number of countries in the peaceful exploration of space, on the basis of and with allowance for the modern level of space technology and the prospects in this field, as well as the real requirements of the countries participating in the cooperation.

The Soviet Union is intent on undertaking the most active participation in implementation of the proposed program in all its stages. We are ready to exchange our achievements in space with all states and to launch peaceful space vehicles of other countries and international agencies using Soviet booster rockets under mutually advantageous conditions.

The Soviet program thus provides for the use of achievements in cosmonautics in the interests of our country and all mankind. It must be stated, however, that the further direction of our space program will be determined in many respects by the actions of the American side.

A confirmation of the peaceful direction of our program for the coming five years is the planned international space flights of Soviet cosmonauts with citizens of Syria, Bulgaria and France. Among the major projects is study of the Martian satellite Phobos and a number of other multisided scientific programs implemented by the USSR in collaboration with the socialist countries, India, Austria, Great Britain, Netherlands, France, FRG, Switzerland, Sweden, Finland, other countries and the European Space Agency.

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ADVANTAGES OF MANNED LUNAR BASE

Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 87 pp 60-68

[Article by V. V. Shevchenko, Doctor of Physical and Mathematical Sciences; "Is the Moon to Be Inhabited?"; the first paragraph appears in boldface in the source]

[Text] The Soviet Union has submitted to the member-states of the UN a stage-by-stage program for joint operations in the peaceful development of space. The program goes up to the year 2000. It is suggested that conditions be created during that period of time that will enable the practical development and use of the moon to begin as early as the first decades of the 21st century, with lunar settlements used as a base for flights to other planets. This would signify the creation of the actual prerequisites for Earth's civilization becoming, at the very beginning of the third millennium, an interplanetary civilization.

'Lunar Renaissance'

After a long lull in space-based lunar research, specialists are again turning their attention to our planet's natural satellite. Predictions are being made that the final decade of our century may signal a new, active phase: a "lunar renaissance," in the parlance of those enthusiastic about returning to the moon in long-range space programs.

The last Apollo mission left the moon in December of 1972. The last unmanned flight to the moon, by Luna-24, which returned to Earth with lunar samples, took place in mid-1976. According to published forecasts, the next scheduled launches to the moon will be no earlier than the late 1980s or early 1990s.

Suggestions are being made more and more often that a manned scientific base will be operating on the face of the moon by the 50th anniversary of the launch of the first artificial earth satellite. Attendees at impressive symposia are discussing the details associated with the organization and operation of the first extraterrestrial human settlement. The principal

conclusion of these discussions is that continued lunar research and the exploitation and efficient use of the resources of our natural satellite represent an extremely critical, and inevitable, stage in the further development of space. Although the execution of the project can begin no earlier than the year 2000, specialists at the Johnson Space Center in Houston feel that now is the time to begin a detailed study of the main aspects of the problem and to begin formulating a general strategy for the development of the moon, which will become a stage in the creation of a polyglobal civilization.

The scientific merit of a long-term lunar laboratory has never been disputed, since it opens essentially new possibilities for solving fundamental problems associated with the origin and evolution of the solar system--among them, problems associated with the early history of the Earth--and enables us to use brand new means of studying near and outer space and to conduct unique experiments in the fields of physics, chemistry, and biology and in many branches of other fundamental and applied sciences. The details of the execution of the project and, above all, the justifiability of the material and technical expense it would involve have not been so clear. Recent predictive studies conducted in the field of cosmonautics, however, provide some detail to this aspect of the problem.

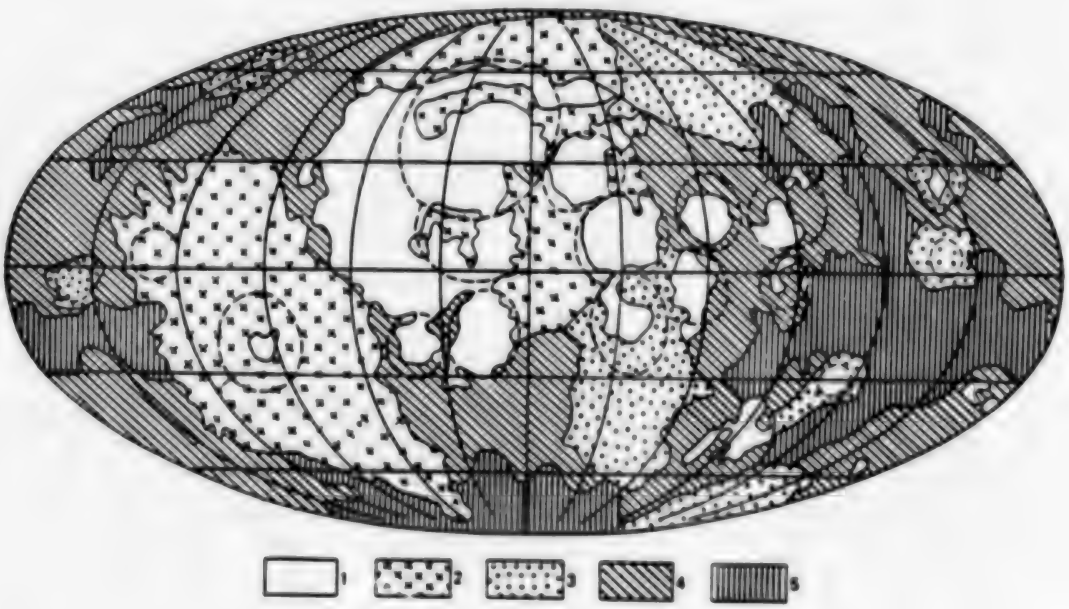
Indications are that, in creating large structures in high near-earth orbits, it would be more economical to use lunar materials for manufacturing things like the radiation shields of manned spacecraft. Well-publicized projects involving the erection of orbiting solar power stations are also impossible without drawing on lunar resources and lunar industry.

The operation of a research laboratory on the moon will help in the solution of an extremely wide range of problems, a complete list of which even now is difficult to enumerate. It appears that specific studies that include systems research techniques are needed, since the specifications of a lunar scientific station are such that efforts in one field inevitably overlap the interests of certain other fields that are often quite different in terms of the direction they take. At its current level of research, the scientific program for a lunar base can only be described as fragmented.

'Museum of Unique Antiquities'

In spite of the intense lunar research that was conducted from space in the 1960s and 1970s, many problems remain unresolved. In particular, the principal "virtues" of the moon as the guardian of the most valuable information on the early stages of the evolution of the solar system have yet to be sold to the proper extent. Modern concepts of the nature of the moon presume the presence of surface formations that came about as a

result of processes that occurred in the solar system during the first 500 million years of its existence. There is no need to go about a lengthy proof of the importance of this information in solving not only the fundamental problems of natural science, but also many practical problems associated with the study and use of the Earth's natural resources. One school of thought holds that the moon had an outer, molten shell several kilometers thick during its formation. If a similar process took place on the Earth, it would have considerable significance in terms of the formation of the core and the mantle. In which case, an intense bombardment of the Earth's surface by falling fragments of solid material (the traces of such a bombardment are distinctly visible on the lunar surface) could have had a considerable effect on the evolution of the continents during a period that began 3.8 billion years ago.



Regions formed on the lunar surface in various ages: 1--maria, the youngest regions; 2--ejecta of the period when the ring structure of Mare Imbrium was formed; 3--ejecta of an earlier period--when the ring structure of Mare Nectaris was formed; 4--old (in terms of age) cratered surface of the continents; 5--oldest, heavily cratered continental surfaces

The answers to the questions, What is the age of the crystallization of the most ancient lunar rocks? and To what degree does the composition of lunar rock change with depth? could probably be provided by studies of samples taken from

ancient intrusions and the lower part of the crust. We can assume that similar samples exist among the ejecta of mammoth multi-ring structures--basins. The lunar basins, some of which are filled with the rock of mare lavas [porody morskikh lav] and are now circular lunar maria, probably formed as a result of the impact of bodies whose diameter was no more than 200 km and that struck the lunar surface with a shock velocity on the order of 8 km/sec. According to calculations, the volume of the original depression of one of the largest basins on the moon--Mare Orientale--is (0.4-1.2) x 10^6 km^3. If the shape of the original depression were nearly spherical, then the pre-impact depth of the ejected blocks of Mare Orientale would be 6-20 km. A similar assumption for Mare Imbrium yields depths of between 8 and 27 km. If the absolute age of lunar brecchia has been determined, one can establish roughly when the depressions of the circular maria formed on this side of the moon. According to such analyses, the multi-ring basins were formed in the earliest period of lunar history, in the interval from 4.25 billion years ago to 3.85 billion years ago.

Comprehensive studies of the ancient regolith in the open areas of the moon as well as a study of the natural outcrops of the deeper layers promise to produce unique data on the possible exchange of matter between the Earth and its satellite and on events in the early history of our planet. It has recently come to light that fragments of lunar material that were hurled from the moon as a result of severe impacts can be found on the Earth's surface. Meteorites recently discovered in Antartica are quite probably also lunar debris. The opposite would also seem entirely possible--that a powerful explosion associated with an impact could have cast particles of matter into near-earth space with enough velocity that they could have overcome the pull of the Earth's gravity. Some suggest that there have been specific periods in the Earth's history in which large bodies rather frequently struck the surface. Only barely noticeable signs of comparatively recent catastrophic events are preserved in the Earth environment. It has not been ruled out that traces of mammoth ejecta from the Earth would be more distinct on the moon, forming conspicuous layers that include particles resembling microtectites.

The layer of regolith 65 million years old, for example, may become a target of investigation on the moon. That time frame corresponds to one of the largest ecological catastrophies in the history of the Earth, one that led to the extinction of more than half of the species of plants and animals that existed on our planet, among them animals such as the dinosaurs. Since geochemical analysis has identified an elevated content of the rare metal iridium in fossils of that period, scholars have suggested that those tragic events are linked to a sharp increase in the frequency with which comets and asteroids struck the Earth. Elevated iridium content is more characteristic of

data associated with space material than with terrestrial surface rock.

Using existing materials and applying statistical analysis methods to study the distribution of crater density, one can restrict the area of investigation substantially. Of practical interest in this regard is the relationship between the age determined by the degree of deterioration of crater features and the absolute age of formation of the area under study. There are yet other techniques that, using photographic analysis of the lunar surface, enable the isolation of well-preserved sectors that could possibly contain regolith that is, for example, 65 million years old. Careful study of such sectors right on the lunar surface will probably help identify the scatter zone [zona rasseyaniya] for materials hurled from Earth.

Unusual brightness formations [yarkostnyye obrazovaniya] on the lunar surface have aroused interest in recent years. In terms of optical properties and topography, these sites are anomalies. The formations are not reflected in the relief, and their visually identifiable boundaries do not coincide or correlate with the relief forms. Light or dark structures forming figures that resemble the turbulence patterns in gaseous media are characteristic signs of brightness anomalies. This analogy appears to be quite unusual for the lunar environment, which is why special attention is being devoted to the formation data. A reliably confirmed link exists between albedo anomalies and magnetic anomalies. The nature of a similar dependence among physical properties remains to be elucidated. Still of interest is a hypothesis according to which diffuse structures are traces left on the surface by the impact of comet nuclei. A thorough in situ study of the diffuse structures--which depends on the possibility of a lunar base--also has a direct bearing on the problem of global catastrophes in the inner portion of the solar system, since, according to preliminary estimates, the age of such lunar formations is somewhat less than 100 million years.

Completely vulnerable to influences from outer space, the lunar surface has preserved a "record" of the events of the early history of our star, the sun.

Studies of the first lunar samples delivered to Earth have already detected tracks on particles of lunar regolith--traces of fast, heavy nuclear particles of solar and galactic origin. The tracks left by heavy nuclei of galactic emissions make it possible to estimate when the fractionate matter reached the surface and to recreate the history of the mixing and deposition of the soil at the collection point. Direct irradiation with heavy nuclei of solar origin leads to a phenomenon in which the density of the tracks changes sharply at a given depth below the

Structure of the surface layer of the moon--regolith. The photo was taken from a lunar rover

surface. Studying such variations enables one to determine the rate of erosion of the parent rock during the early history of the moon. If the time of irradiation and the rate of erosion are known, it is not difficult to calculate the level of flow of solar particles in the past, in other words, to conjecture on solar activity in the distant past.

Until now, samples collected at the surface and particles from soil cores whose length was initially never more than two meters have been studied in the same manner. But if field geology methods were used on the moon, samples of ancient regolith could be taken from outcrops of layered structures reaching hundreds of meters in depth. Such natural outcrops are confined to fairly deep fractures or to the inside slopes of large craters, to locations where the steepness of the slopes do not allow a concealing layer of regolith to accumulate.

Local Raw Material for the Lunar Base

Designers of the lunar settlements of the future must above all think about using the natural resources of the moon for the life-support system.

One such problem, in addition to its purely scientific importance of acquiring for the lunar base a decidedly practical value, involves volatile substance production and modern endogenic processes on the moon. In spite of the fact that existing data suggest that the lunar interior is solid to a depth of hundreds of kilometers, often the so-called transient phenomena that are observed on the moon point to current activity in its interior. Such transient phenomena include short-term glowing, darkening, bursts, color changes, cloudiness, and attenuation of the brightness of stars just before they are covered by the moon. At this point, the catalog of quickly passing phenomena noted by observers already contains hundreds of occurrences. Unfortunately, the overwhelming majority of the observations are visual observations. The fact that gases are vented from the lunar interior, however, is also addressed by data obtained with detectors that were placed on the moon, and, in addition, by the results of measurements made with alpha-spectrometers that were used on the Apollo-15 and -16 lunar orbiters.

The link between transient phenomena and endogenic processes is indirectly confirmed by certain congruences between manifestations of surface events and the seismicity of the interior. It may be that within the lunar interior there exists a system of superdeep fractures at whose interfaces occur processes that generate seismic phenomena and short-term surface events. Tidal disturbances serve as the actuating mechanism for them.

Lunar rock and soil are completely desiccated. The overall low content of volatile elements in the lunar samples studied on Earth signifies that their initial moisture content was itself low. Moreover, two existing spectrograms of short-term phenomena on the lunar surface point to the presence of hydrogen and carbon in products that are presumed to be releases of subsurface gases. If these discharges are from underground reservoirs that are comparatively shallow, then the agglomeration of outgassing products on the lunar surface is possible under certain conditions. Hence the suggestions that methane, carbon dioxide, hydrogen sulfide, and condensed water could accumulate in the polar regions, on the inner walls of craters that are never illuminated by the sun. The surface temperature in the permanently shaded sectors of the polar craters is 120 K or lower. For that reason, a layer of rime that consists of aqueous ice mixed with carbon dioxide, methane, argon, and other components can be as thick as several meters, according to an optimistic point of view. Several laboratory studies, however, have shown that the overall rate of erosion of aqueous ice caused by the various interplanetary and magnetospheric emissions coming from all directions is roughly comparable to the expected rate of formation of the layer of

frozen water. Thus, even in the very coldest areas of the lunar polar regions, which are always deprived of sunlight, a considerable accumulation of aqueous frost and ice is highly improbable. Special experiments conducted from aboard an artificial satellite equipped with the appropriate instruments--a gamma spectrometer and an electromagnetic probe--can resolve the question of the existence of water on the moon once and for all.

Predictions of the derivation of oxygen and water from the surface rock of the moon are more definite. Three basic rock-forming minerals on the moon contain a considerable amount of oxygen in various compounds: pyroxene, 44%; plagioclase, 46%; and ilmenite, 32%.

Most promising, from an engineering point of view, is a technique of obtaining water vapor from surface rock rich in ilmenite. Heating the raw mineral to temperatures near 1000° starts a reduction process that produces roughly 10% oxygen by weight. On the moon, the reduction agent can be hydrogen, which the lunar soil is saturated with as a result of irradiation by solar-wind protons. When ilimenite rock is used as the raw material, pure iron is a by-product of the reduction process. Ilmenite is an ore mineral and is found in quantities of up to 20% in so-called high-titanium mare basalts [morskiye bazalty] of the moon.

A characteristic sign of ilmenite-containing rock is the presence of dark, opaque inclusions, which has a direct effect on the overall reflecting power of the substance. As a result, such rocks have a very low albedo, that is, they are the darkest of the mare basalts. Studies of the samples brought back to Earth show a relationship between the surface-layer content of titanium oxide, which is part of the chemical formula of ilmenite, and the increased reflecting power in the near-UV region of the spectrum. This means that a preliminary forecast of the presence of ilmenite-containing rock can be made simply on the basis Earth-based telescope data. The darkest sectors that show an elevated reflecting power in the blue lines of the visible spectrum can be confidently assumed to be regions with ilmenite basalts.

Solar radiation can serve as the primary source of energy for a lunar base. Of course, the use of other sources, whose operation does not depend on the time of day--advanced nuclear-energy stations, for example--have not been ruled out.

Using lunar materials for erecting various structures is practicable. Engineers and architects feel that the fine lunar dust, which is abundant on the surface, will serve as an excellent material for cement mixtures and concretes.

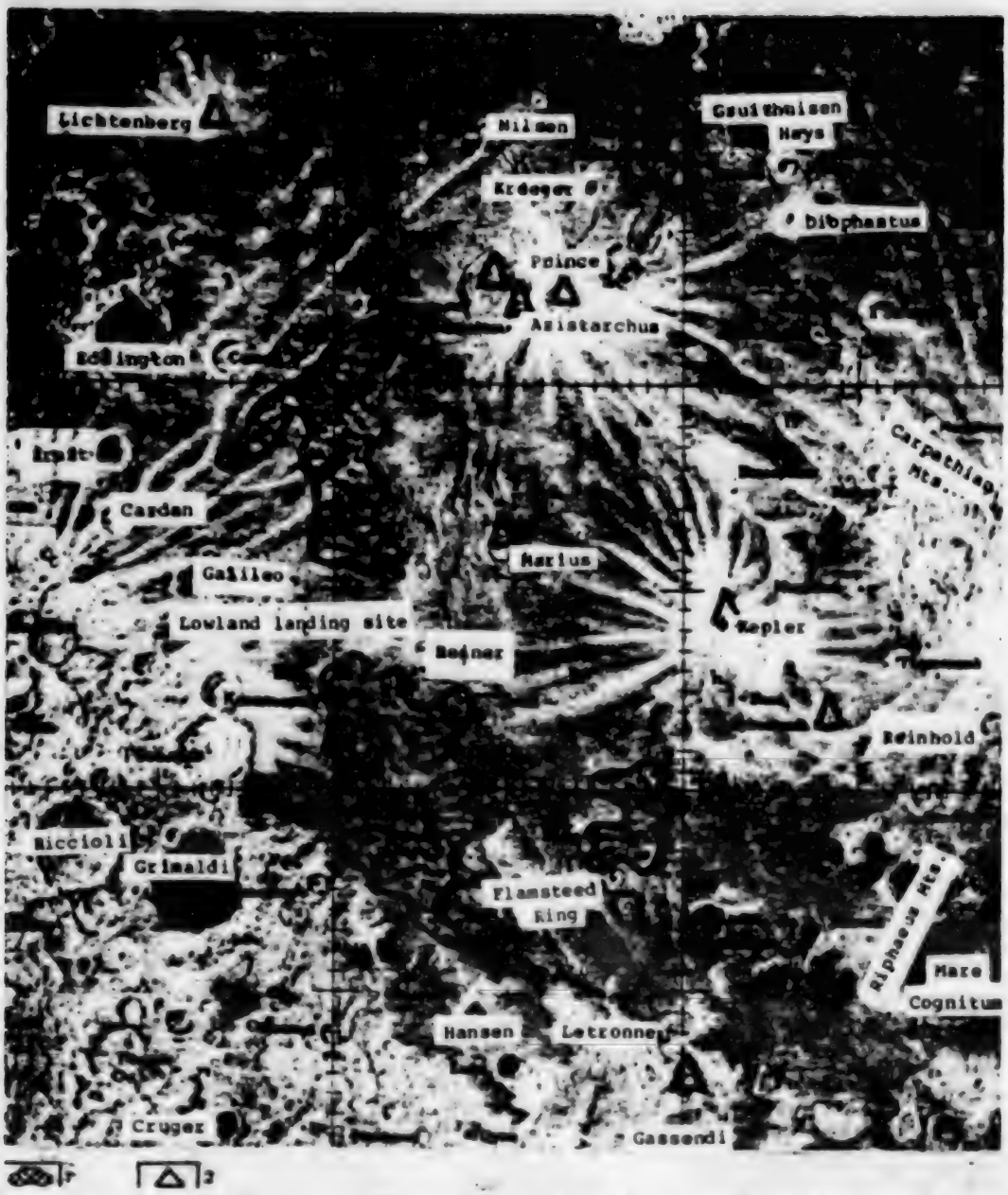
Lunar Settlement of the Twenty-First Century

The first projects involving a permanent lunar base appeared more than twenty years ago. The International Astronautical Federation created a special committee to coordinate the development of a plan for a scientific laboratory on the moon. The joint work of the scientific organizations of a number of countries in the study of Antarctica served as a model of international cooperation.

After the lunar programs of the 1970s wound down, the leading space powers concentrated their primary energies on the study and development of near-earth space with manned spacecraft. As a result of the experience they had garnered, as well as their forecasts, a group of specialists from the Department of Solar System Research [Otdeleniye issledovaniy Solnechnoy sistemy] at the Johnson Space Center (in Houston) concluded that in the next few decades the concept of "near space" will inherently include the moon. The great possibilities of lunar industry will have a significant effect on the development of all of near-earth space within the moon's orbit. Therefore, the development of a plan for a manned lunar base again becomes urgent.

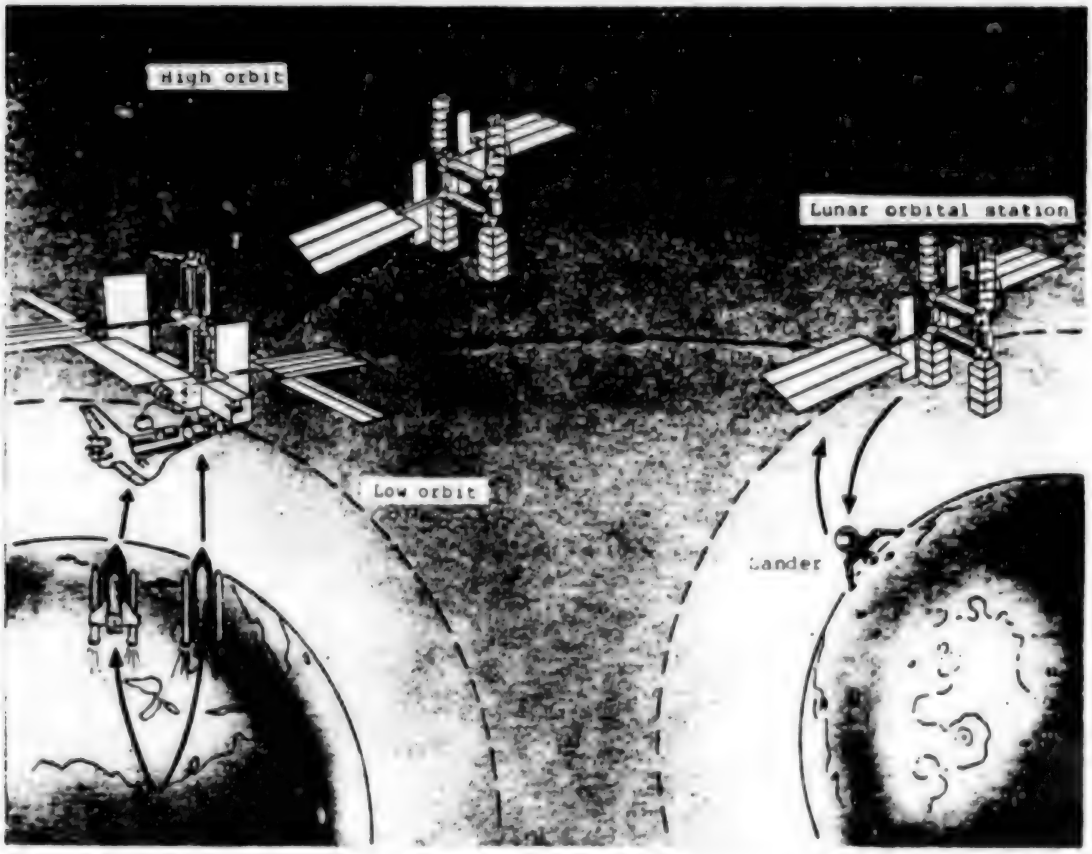
A number of variants are being examined. The simplest route to take is this: after a suitable spot has been chosen for the base, automatic industrial equipment for working the lunar soil are sent to the lunar surface. The best place for the complex is thought to be the Oceanus Procellarum, an area in the region between 55° and 65° longitude, near the equator. When the automatic units have begun their work and have dug a given amount of the needed resources, a module that will serve as living quarters will be added to them. A lunar vehicle remotely controlled from Earth will place the module in either a natural or a specially created depression in such a way that a layer of lunar regolith can then be used to protect it from radiation as well as from overheating in the daytime and rapid cooling at night. By the time the first party of inhabitants of the lunar base land, the automatic units will already have completely set up oxygen and water production that is based on local materials; hydrogen, however, will have to be delivered from Earth at first. Ensuing flights will bring whatever equipment is needed and other crew members, up to 12 in all.

A more complex program calls for the preliminary phase to include a series of reconaissance and engineering flights of not only unmanned vehicles, but also manned vehicles. It is suggested that a large space station in near-earth orbit be used as an intermediate transport base, and that the direction of all the operations on the moon be carried out from a station in near-lunar orbit.



Western part of Oceanus Procellarum: 1--region assumed to have ilmenite basalts (based on data of Earth-based telescopic observations); 2--sites where transient phenomena were noted a number of times

Each living-quarters module in the lunar settlement can be made of an aluminum cylinder placed in a depression nearly 3 meters deep and covered on top with a protective layer of soil 2-5 meters thick. Life support will be provided by a closed-loop ecological system that uses recycled water and air. Since the oxygen needs will be met entirely by local resources, only nitrogen and water, or hydrogen for deriving water in the industrial units, will have to be delivered from Earth. Plants can be grown in lunar soil in a special greenhouse module. The production of green plants will provide additional oxygen. This makes it feasible to raise small domesticated animals that

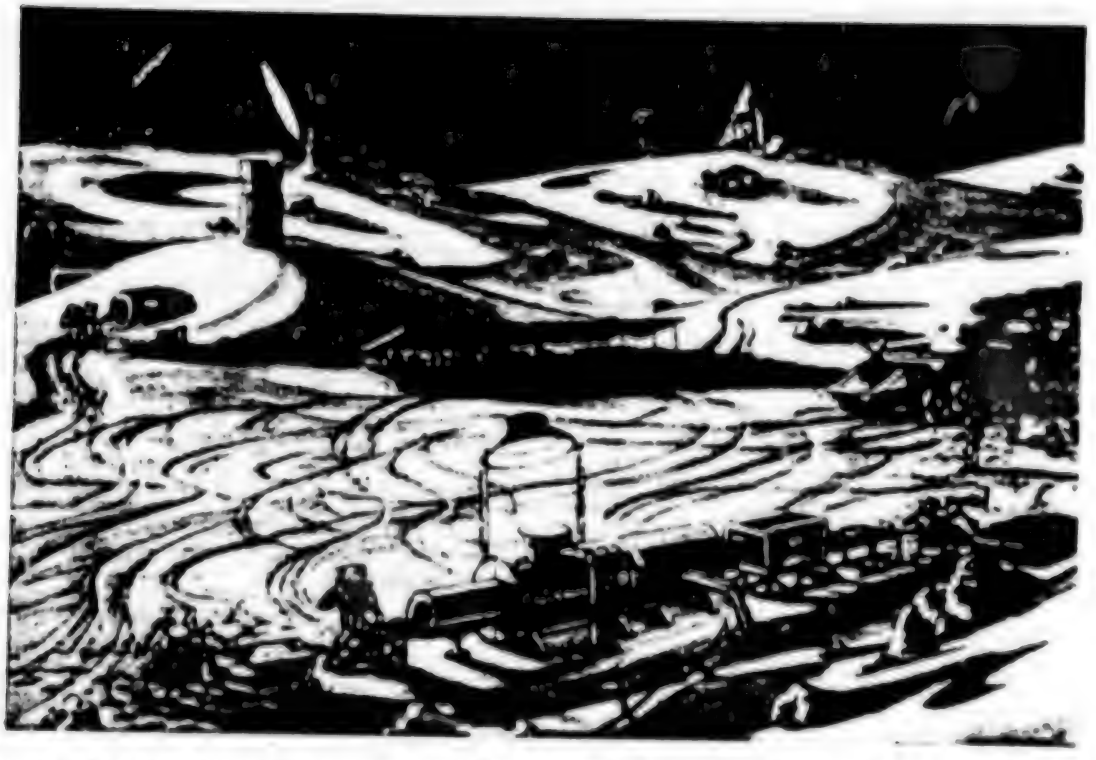


Transport operations in the creation of a lunar base; near-earth and near-lunar orbital stations are used (one of the American projects)

reproduce rapidly (rabbits, for example) in order to provide the base's inhabitants a balanced diet.

Scientific and industrial facilities can have whatever structure best suits their function. The absence of an atmosphere and the weak gravitational pull make it possible when necessary to create light-weight, economical, but very large structures. It is proposed, for example, that a 25-meter optical telescope be built on the moon. Such an instrument is capable of producing a resolution of 0.0001 second of arc. With a moon-based telescope of this sort, we would probably be able to observe the planets of the nearest stars and details of the nuclei of neighboring galaxies.

Accomplishing such a grandiose project as the creation of the first human settlement on one of the bodies in our solar system will require considerable material expense, which, for individual countries, will be substantially lower in the context of an international collaboration.



A lunar base under construction could look like this. In the foreground is a unit for processing lunar rock. On the left is the entrance to the living quarters, which are covered with a protective layer of lunar regolith.

The author of this article spoke with the project planners--specialists from the Johnson Space Center. In these conversations, as well as in their own publications, the scientists came out in favor of consolidating the efforts of various countries--above all, the space powers--which would help to achieve not only scientific aims, but also the further development of space for peaceful purposes.

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SPACE POLICY, ADMINISTRATION

GLAVKOSMOS STATES REENTRY OF 'COSMOS-1871' POSES NO HAZARD

Moscow PRAVDA in Russian 10 Aug 87 p 8

["Report of Glavkosmos USSR"]

[Excerpt] An artificial Earth satellite, "Cosmos-1871," was launched from the Soviet Union on 1 August 1987. A report of its launching and calculated orbit was published in the press on 4 August 1987.

The satellite has a mass of 10 tons.

Measurements of the flight path of the satellite "Cosmos-1871" and calculations of its orbit which have been made indicate that its entry into the dense layers of the Earth's atmosphere and fall will take place on 10 August during the first half of the day. Individual parts of the satellite will be dispersed over an extensive area, and the likelihood of damage on the Earth's surface is negligible. The "Cosmos-1871" satellite carries no loads that present an additional threat to life. The most likely area of dispersion is the southern part of the Pacific Ocean, near Antarctica.

Every year, about 150 spacecraft launched by different countries end their active existence in a similar manner: they enter the dense layers of the atmosphere, most of them burn up, and a portion of them are scattered over the Earth's surface.

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NEW SCIENTIFIC COUNCIL FOR AEROSPACE STUDIES

Leningrad LENINGRADSKAYA PRAVDA in Russian 22 Jul 87 p 2

[Abstract] The article is an interview with Doctor of Technical Sciences, Professor Anatoliy Alekseyevich Buznikov of the Leningrad Electrical Engineering Institute, who is a member of a new specialized scientific council for space-based studies in support of economic development. It is noted that this council was created recently by decision of the presidium of the USSR Academy of Sciences. One of its tasks is to ensure maximum utilization of aerospace means and methods for studying the natural resources and environment of the country's northwest region, particularly the ecology of the area around Leningrad, including the Baltic Sea and Lake Ladoga.

Buznikov pointed out that Leningrad has perhaps the country's largest number of specialists working on remote means of studying the Earth from space. In the past, their work was not well-coordinated, and there was duplication of efforts. The council therefore was created to help make optimum use of these scientific resources. In addition to associates of leading scientific organizations of Leningrad, the council also includes representatives from other cities who work in this field. The head of the council is academician K.Ya. Kondratyev.

Buznikov related that studies of natural resources will account for approximately two-thirds of the council's activity. A leading topic will be nature conservation and study of inland bodies of water. The council's first meeting was devoted to the drafting of a comprehensive program for study of Lake Ladoga, for the purpose of protecting it against further pollution. Wide-scale studies under the "Ladoga" program are supposed to begin in autumn of this year. Information will be gathered at three levels: by researchers working directly on the lake, from airplanes, and from satellites. The chief organization for the program is the USSR Academy of Sciences' Institute of Limnology, and a big part also will be taken by the Main Geophysical Observatory imeni Voyeykov.

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RESUMPTION OF U.S.-USSR COOPERATION IN SPACE BIOMEDICAL RESEARCH

Riga SOVETSKAYA LATVIYA in Russian 22 Aug 87 p 3

[Article by N. Zheleznov, correspondent]

[Text] Specialists of the USSR and the United States who are working in the field of space biology and medicine are resuming active cooperation. Convincing evidence of this was provided by a meeting with participants in a conference of specialists of the two countries which has concluded in our country. This meeting took place in the press center of the USSR Ministry of Foreign Affairs on 10 August.

Academician O. Gazenko stated that the USSR Ministry of Health's Institute of Medical-Biological Problems and NASA's administration for medical-biological research think that the forced interruption of joint research has been left behind. Practically all questions that normal progress will involve have been discussed at meetings held in Moscow, Nalchik and Terskola. Participants in these meetings outlined topics for joint basic research using biological satellites, reached agreement on a procedure for exchanging information on results of manned space missions, and defined questions for the study of promising problems of human exploration of space. It was decided also to begin preparing a joint basic work on results of research during the past 15 years.

The scientists nevertheless had to hurry to answer the journalists' questions, despite the obvious success of the meeting. Why was there no discussion of joint programs of medical-biological research on manned missions? Were problems of preparing medical programs for manned expeditions to the planets discussed at the meeting?

"Our joint programs call for moving ahead, but at not too fast a pace, with the idea of picking up speed in all sectors of research," stated S. Keller, joint director of NASA.

Such speed has already been developed in one sector, incidentally. Professor Ye. Ilyin, head of a Soviet program of research using biological satellites, reported to the journalists that preparations for the flight of the next Soviet biological satellite are nearing completion. The program of research on board this satellite includes about 30 Soviet-American experiments.

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SPACE POLICY, ADMINISTRATION

PROPOSED SOVIET SCENARIO FOR MARS RESEARCH DISCUSSED AT INTERNATIONAL MEETING

Moscow GUDOK in Russian 8 Aug 87 p 4

[Article by Yuriy Gordeyev]

[Excerpt] In April of this year, E.A. Shevardnadze, USSR minister of foreign affairs, and G. Shultz, U.S. Secretary of State, signed an agreement in Moscow on cooperation in the peaceful study and use of outer space.

The flight of an international crew to the planet Mars would be a tremendous success for science. The majority of scientists nevertheless think that such a flight should be preceded by unmanned missions. One of the most promising plans that Soviet scientists have drafted was discussed recently at an international meeting in Pasadena (USA). It is a scenario for launching a series of unmanned spacecraft to Mars for the purpose of studying this planet comprehensively and delivering specimens of Martian soil to Earth.

This scenario calls for employing such research equipment as balloons, which would be used for studying the planet's air blanket. They would land on the planet's surface and ascend again. The equipment also includes probing devices which would penetrate fairly deeply into the planet's surface, and Mars rovers capable of examining large areas. The delivery of Martian soil would in essence provide a model for a subsequent manned flight over an Earth--Mars--Earth route.

"Everyone agrees that this would make it possible to solve mysteries which excite people, such as the origin and geological history of Mars, including the history of water on it," noted academician R.Z. Sagdeyev, director of the USSR Academy of Sciences' Institute of Space Research. "Perhaps light would also be shed on the hypothesis that life once existed on Mars."

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SYRIAN OFFICIALS VIEW LAUNCH OF 'SOYUZ TM-3' AT BAYKONUR

Moscow PRAVDA in Russian 22 Jul 87 p 1

[Abstract] The article reports on publicity and ceremonial functions that preceded the launch of the "Soyuz TM-3" spaceship with a Soviet-Syrian crew. Remarks of Syrian cosmonaut M. Faris and of Soviet cosmonauts A. Viktorenko and A. Aleksandrov are recorded. Faris mentioned that during the time of the visiting crew's mission on board the "Mir" orbiting complex, they would fly over the territory of Syria three times, and that photographs would be taken in the interests of geology and environmental protection. It is also reported that on 21 July a government delegation from the Syrian Arab Republic arrived at the Baykonur Cosmodrome to witness the launch of the spaceship. This delegation was led by General M. Tlas, deputy premier and minister of defense of the Syrian Arab Republic. Accompanying the delegation were academician V. Kotelnikov, vice-president of the USSR Academy of Sciences and chairman of the "Intercosmos" council, and General-Lieutenant of Aviation G. Titov, pilot-cosmonaut of the USSR.

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LIST OF RECENT SOVIET SPACE LAUNCHES

Moscow TASS in English or Russian various dates

[Summary]

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
22 Jul 87	Soyuz TM-3	(Commander: Aleksandr Viktorenko, Flight-Engineer: Aleksandr Aleksandrov, Cosmonaut-Researcher: Mohammed Faris [Syria])			
25 Jul 87	Cosmos-1870	282 km	168 km	88.7 min	71.9°
		(Remote sensing satellite; for testing of onboard systems' design & instruments and experiments in interests of science & the national economy in areas of hydrology, cartography, geology, agriculture & environmental study; orbited by Proton booster)			
1 Aug 87	Cosmos-1871	212 km	191 km	88.3 min	97°
4 Aug 87	Progress-31	269 km	193 km	88.8 min	51.6°
		(To deliver expendables to the "Mir" complex)			
18 Aug 87	Meteor-2	974 km	954 km	104.1 min	82.5°
		(Meteorlogical satellite to obtain global imagery of cloud cover & underlying surface in visible & IR ranges in memory or direct transmission mode; also carries radiometry equipment for monitoring flows of penetrating radiation in near-Earth space; data goes to State Sci.-Res. Center for Study of Natural Resources & USSR State Committee for Hydrometeorology)			
19 Aug 87	Cosmos-1872	333 km	208 km	89.6 min	72.9°

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
28 Aug 87	Cosmos-1873	274 km	186 km	88.8 min	64.8°
		("The 'Cosmos-1873' flight program is analogous to that of 'Cosmos-1871')			
3 Sep 87	Cosmos-1874	333 km	208 km	89.6 min	73°
3 Sep 87	Ekran	35,539 km	--	23 hrs 43 min	0.4°
		(TV satellite for broadcast of Central TV in decimeter waveband to network of collective use receivers; near-stationary, circular orbit)			
8 Sep 87	Cosmos-1875 -- Cosmos-1880	1,437 km	1,401 km	114 min	82.6°
		(Six satellites orbited by single booster)			
11 Sep 87	Cosmos-1881	297 km	190 km	89 min	64.8°
15 Sep 87	Cosmos-1882	253 km	196 km	88.6 min	82.3°
		(For continued research on Earth's natural resources; data goes to State Sci.-Res. Center "Priroda" for processing & use)			
16 Sep 87	Cosmos-1883, -1884, -1885	19,133 km	--	11 hrs 15 min	64.9°
		(Three satellites launched by single Proton booster; to develop elements & apparatus of a space navigation system for location of civil aircraft & vessels of the sea-going and fishing fleets of the USSR; near-circular orbit)			
17 Sep 87	Cosmos-1886	384 km	178 km	89.8 min	67.2°
24 Sep 87	Progress-32	267 km	193 km	88.8 min	51.6°
		(To deliver expendables to the "Mir" complex)			
29 Sep 87	Cosmos-1887	406 km	224 km	90.5 min	62.8°
		(Biological satellite to study effects of space-flight on monkeys & other subjects, as well as apparatus for radiation & physics research)			

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